

COLORADO DEPARTMENT OF TRANSPORTATION STAFF BRIDGE BRIDGE DETAIL MANUAL	Chapter: 16 Effective: December 15, 2010 Supersedes: New
Repair Details	

### 16.1 Purpose

Repair drawings graphically present all pertinent information necessary in the field construction of repairs to a structure. Some of these repair types include:

- (A) Bridgerail Replacement
- (B) Expansion Joint Replacement
- (C) Deck Rehabilitation
- (D) Pier Cap and Column Repair
- (E) Impact Repair
- (F) Corbel Placement
- (G) Timber Pile Repair
- (H) Timber Bridge Girder Repair
- (I) Falsework
- (J) Wall Repair
- (K) Steel Corrosion/Fatigue Repair

More than one kind of repair may be included in a drawing set for a given structure or multiple structures, e.g. deck rehabilitation and expansion joint replacement may share the same general layout. Figure 16.1-1 presents a portion of the general information sheet for a repair project that includes multiple structures. The checklists in this chapter will sometimes contain both design issues and detailing issues. The detailer shall verify any unknown design issues with the designer of the repair.

<b><u>BRIDGE DESCRIPTION (E-17-GL &amp; E-17-GM)</u></b> E-17-GL (Westbound) and E-17-GM (Eastbound) are seven span (50'-0" typ.) CSG bridges located on I-76 at MP 7.652. Structures are 30'-0" curb to curb with 2'-0" wide curb on both sides and type 10 rail. The average skew is 68°. The bridges have approximately 4" of asphalt.	<b><u>INDEX OF DRAWINGS</u></b> Dwg. No. B01 GENERAL NOTES AND WORK DESCRIPTION Dwg. No. B02 SUMMARY OF QUANTITIES Dwg. No. B03 GENERAL LAYOUT E-17-GL & E-17-GM Dwg. No. B04 SECTIONS & DETAILS E-17-GL & E-17-GM Dwg. No. B05 BEARING REPAIR DETAILS E-17-GL & E-17-GM Dwg. No. B06 TEMPORARY SUPPORT DETAILS E-17-GL & GM Dwg. No. B07 GENERAL LAYOUT F-16-FL Dwg. No. B08 COLUMN AND PIER CAP REPAIR F-16-FL Dwg. No. B09 BEARING REPAIR DETAILS F-16-FL Dwg. No. B10 TEMPORARY SUPPORT DETAILS F-16-FL Dwg. No. B11 PIER CAP SUPPORT DETAILS F-16-FL Dwg. No. B12 GENERAL LAYOUT AND REPAIR DETAILS E-17-GA & E-17-GB
<b><u>WORK DESCRIPTION (E-17-GL &amp; E-17-GM)</u></b> Install temporary support as shown in the plans. Remove unsound concrete from surfaces of concrete girder and pier cap and place concrete patching as shown in the drawings and as directed by the Engineer. Install corbels under girders as shown in the drawings.	
<b><u>BRIDGE DESCRIPTION (F-16-FL)</u></b> F-16-FL is a four span (31'-8", 50'-0", 50'-0", 31'-8") bridge; concrete on rolled I beam, composite and concrete tee. It is located at the intersection of SH 6 and SH 95 at MP 282.273. Structure is 98'-0" curb to curb with no skew, it has 2'-0" wide curb on both sides. Existing rail type 4.	
<b><u>WORK DESCRIPTION (F-16-FL)</u></b> Install pier cap supports as shown in the plans. Install temporary support as shown in the plans. Remove unsound concrete from surfaces of concrete column and pier cap and place concrete patching as shown in the drawings and as directed by the Engineer. Install corbels under girders as shown in the drawings.	
<b><u>BRIDGE DESCRIPTION (E-17-GA &amp; E-17-GB)</u></b> E-17-GA (Westbound) and E-17-GB (Eastbound) are three span (31'-0", 66'-6", 31'-0") bridges, Concrete Slab and Girder, Composite. They are located on I-70 at MP 278.49 over SH 35 (Quebec Street). Structures are 48'-0" curb to curb with a 0° skew. They have 2'curbs on both sides with Type 10 Bridgerail.	
<b><u>WORK DESCRIPTION (E-17-GA &amp; E-17-GB)</u></b> Remove unsound concrete from surfaces of columns. Sandblast reinforcing steel, place new reinforcing steel as required. Patch concrete removal areas. Apply concrete sealer to pier columns.	

Portion of General Notes Sheet for Multiple Structures  
Fig 16.1-1

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## 16.2 Responsibility

These drawings shall be prepared and checked in the Design Unit. The graphical presentation of information on these drawings shall be the responsibility of the individual preparing the drawings.

## 16.3 Scales

Standard Architectural and Civil scales shall be used that are suitable to make the details legible on a standard sheet.

## 16.4 Orientation of Details

The PLAN of the bridge shall be placed, if possible, at the upper left of the drawing. The location of the repairs should be shown in plan view when possible. The ELEVATION of the bridge shall be projected below the PLAN if necessary for clarifying the repair location. When possible, the END ELEVATION and/or Sections shall be placed to the right of the PLAN and ELEVATION. If space is limited, the sections or secondary views may be shown on another sheet. Generally, sections should be taken from the PLAN and ELEVATION rather than from secondary views or other sections.

## 16.5 Control

For repairs without a field survey, original Horizontal Control Lines, Stationing and Layout Lines are not required to complete the work and should not be shown. All locations or control lines should be dimensioned off of the existing structure. Abutments and piers shall be numbered according to the current inspection report. A note should be added on the drawings if this numbering is different from original drawings, (e.g., "Abutment & Pier Numbers match Structure Inspection Reports, Previous As-Built Drawings may differ.") The display of lane lines and shoulders are helpful for determination of traffic control, but are not required.

## 16.6 Centerlines

Centerlines shall be identified and shown as discussed in the following subsections:

- (a) Location - Centerlines shall be shown on views which help locate the repair, when applicable.

- 1. Plan View

- a) Centerline of all girders

- 2. Elevation View

- a) Centerline of Piers
  - b) Centerline of columns and footings

(b) Identification - The centerlines shall be identified in the following ways:

1. Centerline of Girder - A circle containing the capital letter G, a dash and the girder number or letter is placed on each girder centerline, as shown in the PLAN views of the piers in the graphic examples. The G & dash may be omitted if space is insufficient. These girder numbers/letters shall correspond to those shown in the Inspection Folder. Typically numbers are used for new construction while letters are used for existing structures.
2. Other Centerlines - When it is applicable to identify other centerlines, it should be done by using their particular names. Examples: Centerline Bearing, Centerline Anchor Bolts, Centerline Columns, Centerline Footings, etc.

#### 16.7 Elevations

Elevations are not typically required on repair projects since most of the work is relative to the existing structure. Elevations may be useful in determining scale and clearances.

#### 16.8 Dimensions

A sufficient number of dimensions shall be shown on the details to provide adequate information necessary in the checking of the plans and the construction and/or design of the repair. Quantities should be able to be verified based on plan dimensions.

#### 16.9 Angles

The following angles shall be shown in the PLAN view of the bridge, when applicable.

- (a) Skew angle
- (b) Angles that the girders generate with the centerline of pier or centerline of bearings, if they are different than the skew angle.

#### 16.10 Temporary Support

Some repairs will require temporary support of the girders in order to complete the required work. At a minimum, a conceptual temporary support detail should be provided. See Section 16.12(I).

#### 16.11 Worksheets

The use of the Bridge Worksheets is encouraged, but the designer shall verify the dimensions and applicability of the worksheet for the required repair.



### 16.12 Plan Sheet Information

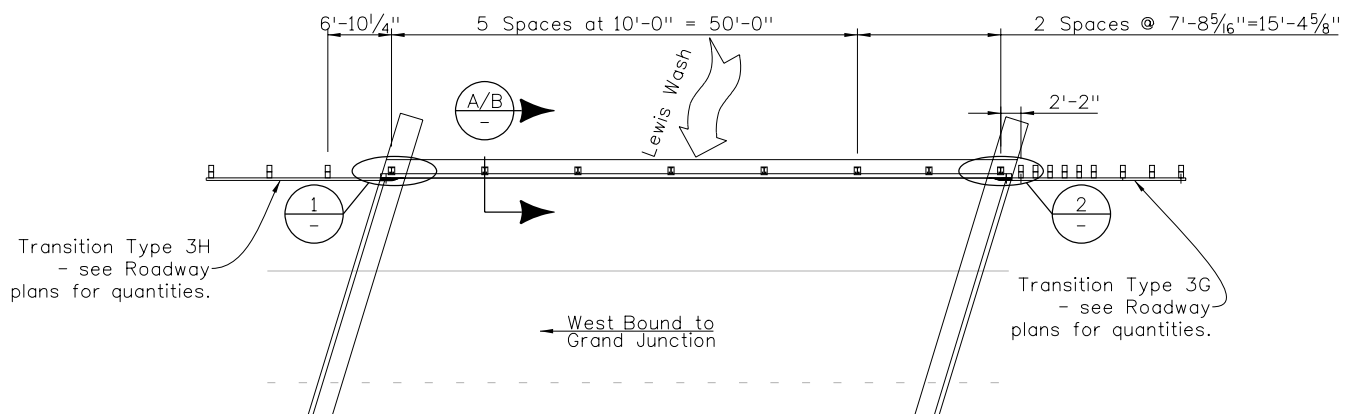
The following paragraphs provide a brief overview of each repair type, a checklist of information that is likely to be required for each repair type, photographs and sample plan sheets. The repair examples shown here are a guide only; each repair shall be evaluated for applicability of examples and worksheets on a case by case basis. See Chapter 1 for border information checking procedures.

- (A) Bridgerail Replacement** - Typically these projects involve replacing substandard bridge rails with new standard rails. The option of missing the existing post locations or matching the post locations is typically determined by the region's bridge unit leader but may be required by bridge restrictions as well.

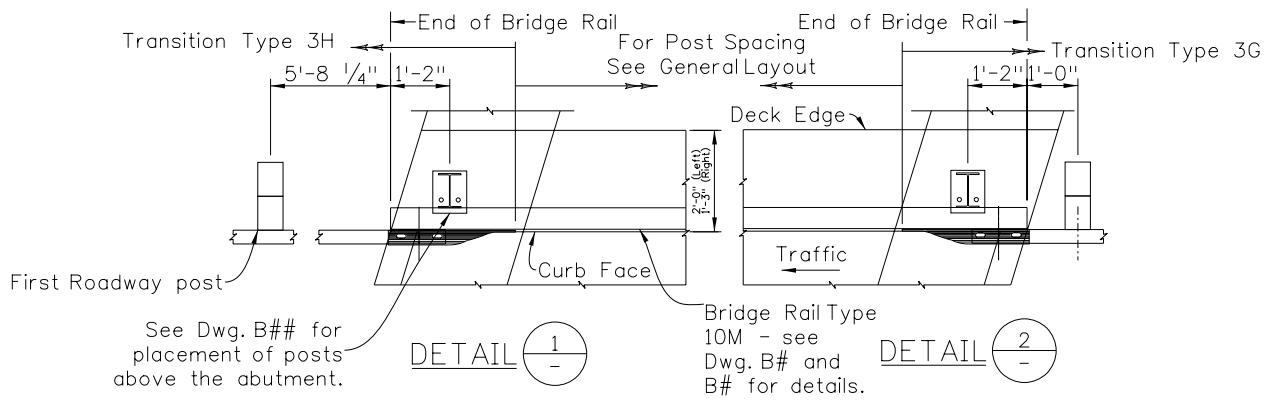
#### Check Items

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts.

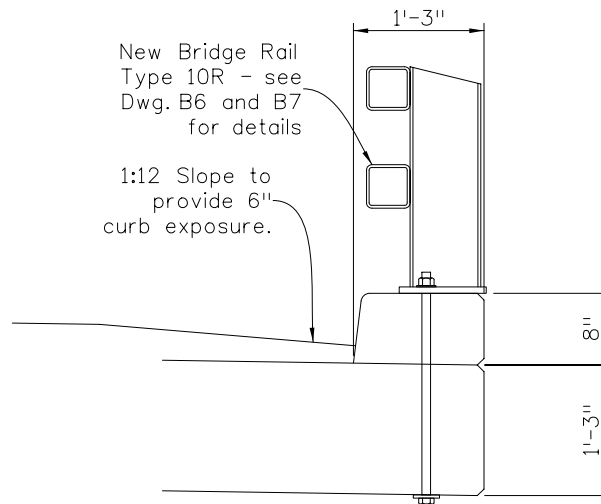
1. Distance from last bridge rail post to end of bridge or approach slab.
2. Standard post to post dimensions.
3. Details to match existing anchor bolts if required.
4. Illustration that standard Guardrail Terminators can be installed without hitting abutment or approach slab.
5. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
6. Vertical profile of bridge.
7. Work Description.
8. Bridge Description.



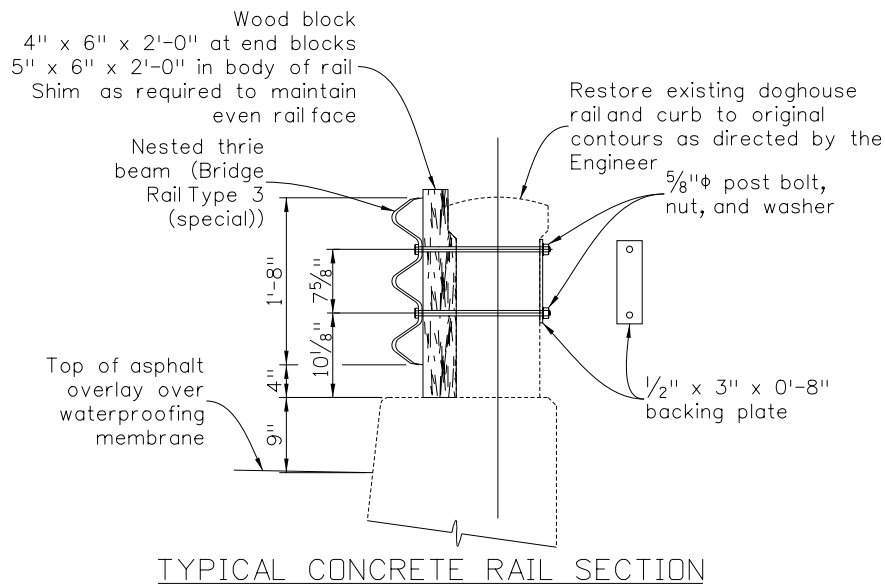
**Sample Plan showing Bridgerail Post Spacing  
Fig 16.12(A)-1**



**Sample Detail showing Bridgerail post locations/clearances near Abutment**  
**Fig 16.12 (A)-2**

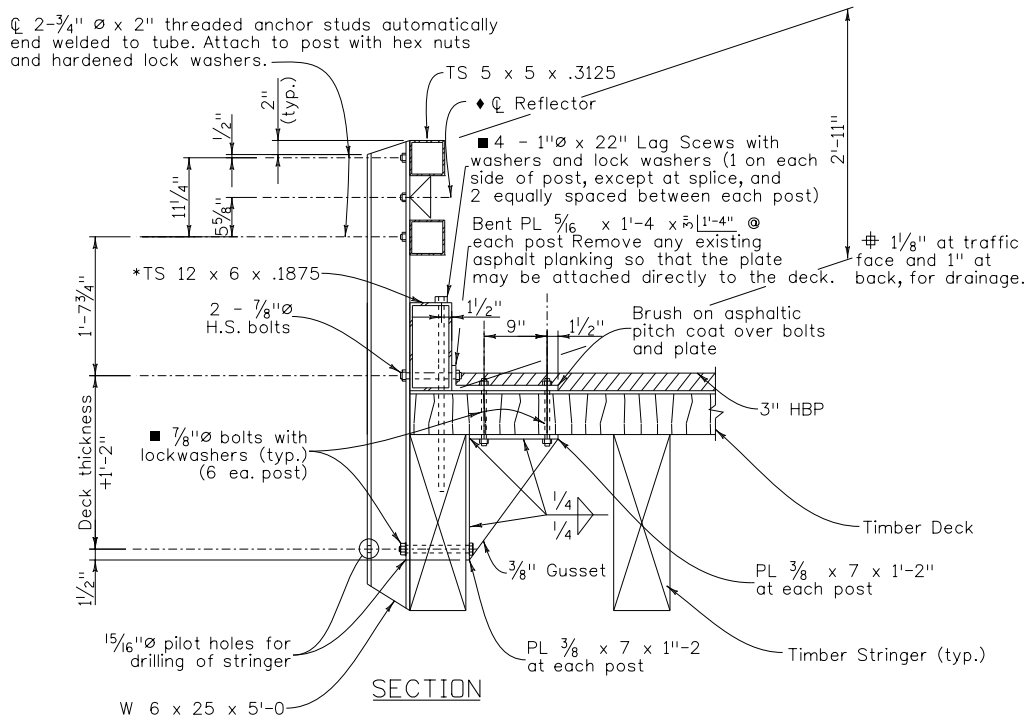


**Sample Section showing paving detail and Post Connection**  
**Fig 16.12 (A)-3**



Notch block as necessary to fit railing

**Sample Section showing Bridgerail Repair for Doghouse Type Rail**  
**Fig 16.12 (A) -4**



- ◆ See M-606-1 for details - attach to post with 5/8"  $\phi$  bolt with hex nut and lock washer
- \* Existing timber wheelguard shall be removed.

**Sample Section showing Timber Bridge Rail Replacement**  
**Fig 16.12 (A) -5**

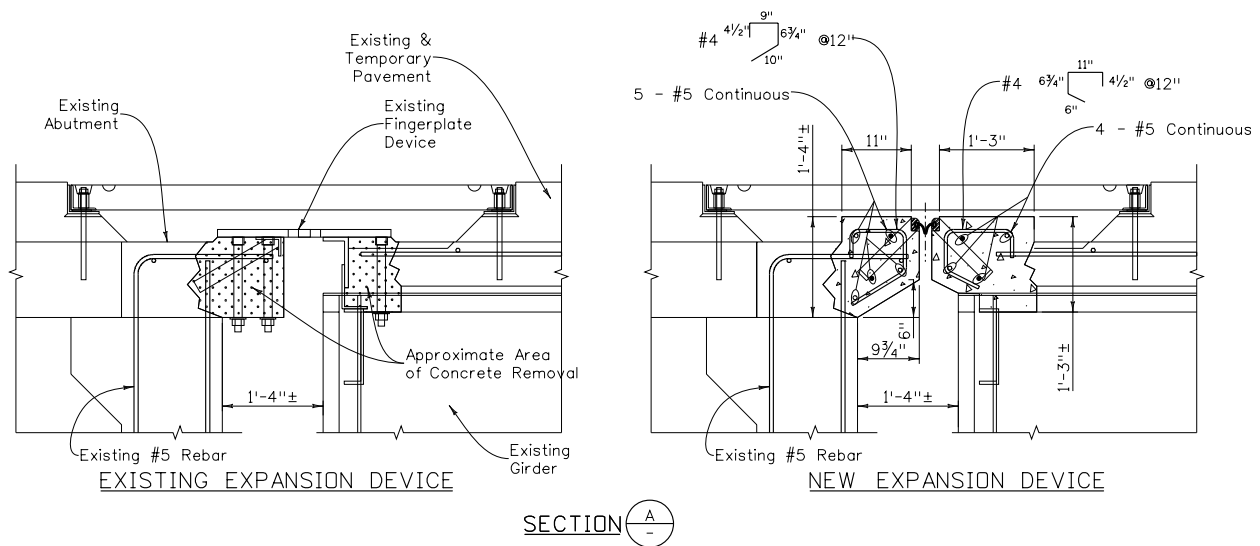
- (B) **Expansion Joint Replacement** - These repairs are typically removal of existing expansion joints and replacement with a new standard expansion joint. Some modular joints can be repaired in place, although the repair longevity is questionable. Expansion Joint Replacement should typically be done with overnight closures if lanes cannot be closed. Provide cover plates if repair area will need to be traversed by daytime traffic.

**Check Items:**

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations, curb heights and conflicts.

1. Existing reinforcing and interferences and resolve issues
2. Existing utilities
3. Depth of concrete removal
4. Depth of asphalt (height of header)
5. Bridge rail type
6. Curb plate size
7. Construction phasing and details
8. Opening dimensions
9. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
10. Work Description.
11. Bridge Description.





Sample Sections showing existing and proposed expansion joint devices  
16.12 (B) -2



Photo of Expansion device detailed above  
16.12 (B) -3



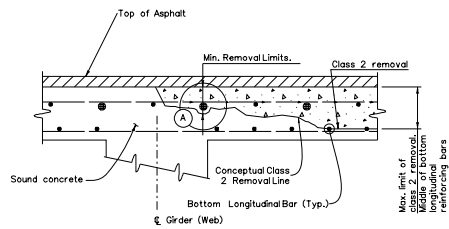
- (C) **Deck Rehabilitation** - Typical requirements for deck rehabilitation include removal of asphalt mat, location of rehabilitation areas, and removal and replacement of concrete. Pay Items for removal vary between regions, e.g. Region 6 construction prefers using only Class 2 & Class 3 Removals. Rehabilitation areas shown are generally conceptual but may be based on deck sonars or mapping of lower side of the deck & soffit. Waterproofing Membrane should be added to extend the life of the deck. A Typical General Layout Sheet is shown in figure 16.12(C)-4.

**Check Items:**

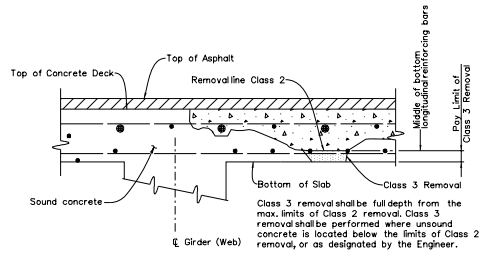
Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts.

1. Approximate locations of rehab, if locations are only conceptual, label accordingly.
2. Length and width of bridge
3. Removal details and pay items.
4. Phasing details
  - i. For cast-in-place concrete boxes, tee girder bridges and other girder types which rely on the deck for stability, show amount of removal permissible without the requirement of falsework.
  - ii. For steel girders, precast girders and other girder types which do not rely on the deck for stability, show permissible amount of removal similar to Figure 16.12(C)-3.
5. Joint details to clarify any interference with rotomilling operations.
6. Existing reinforcing, sizes, and spacing
7. Typical section
8. Depth of asphalt for milling/replacement
9. Existing utilities, especially those in the deck
10. Dimension girder spacing
11. Show drain locations and details
12. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
13. Work Description.
14. Bridge Description.

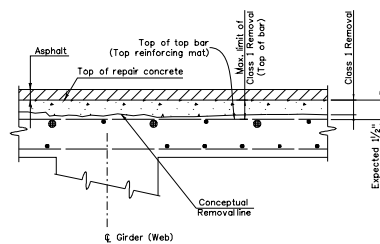




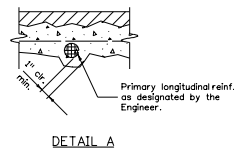
**REMOVAL OF PORTIONS OF PRESENT STRUCTURE (CLASS 2)(SY)**  
To be paid for under Item 202 Removal of Portions of Present Structure (Class 2)(SY)



**REMOVAL OF PORTIONS OF PRESENT STRUCTURE (CLASS 3)(SY)**  
To be paid for under Item 202 Removal of Portions of Present Structure (Class 3)(SY)



**REMOVAL OF PORTIONS OF PRESENT STRUCTURE (CLASS 1)(SY)**  
To be paid for under Item 202 Removal of Portions of Present Structure (Class 1)(SY)



**DETAIL A**

#### NOTES:

The Contractor is responsible for the stability of the structure during construction.

The proposed plan shall be coordinated with the Engineer and performed in a manner as required to insure the structural integrity of the bridge. The Contractor shall be responsible for designing and constructing the falsework per CDDT Standard Specifications for Road and Bridge Construction. Falsework will not be paid for separately but shall be included in the work.

Care shall be taken in removing concrete from around structural steel elements and reinforcing steel to prevent damage to the steel. Any steel damaged during the construction or removal process, will be replaced at the Contractor's expense.

These details reflect the scope and nature of the work. They are not intended to represent the actual structure.

The applicable classes of removal shall be designated by the summary of quantities in the plans.

If Class 3 removal is performed immediately adjacent to, and on both sides of a girder simultaneously within the middle half of a span, that girder shall be shored from the ground at the third points of that span.

If Class 2 or 3 removals performed on both sides of a girder simultaneously within the quarter of a span on either side of the pier, that girder shall be shored at the third point each side of that pier. This note is not intended to require shoring for "pothole" type repairs of limited extent where at least one half of the longitudinal deck reinforcing is anchored on both sides of the removal area.

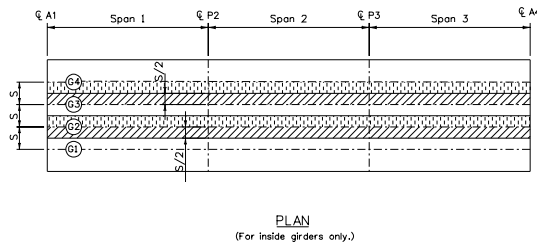
Any damage to the concrete surface of the deck or structure due to error or neglect shall be repaired by the Contractor without compensation or time extension.

ESTIMATED REMOVALS (FOR INFORMATION ONLY)		
CLASS	COMPUTATION METHOD	AREA
CLASS 1	NOMINAL 1/2" REMOVAL FROM TOP OF DECK	X
CLASS 2	1/2 TOTAL DECK AREA	A
CLASS 3	5% OF CLASS 2	0.05 x A

Above areas are for information only. Percentages are provided for estimating purposes and are representative of past projects. Conditions may vary at each bridge site. Actual removal areas are to be determined by the Engineer.

\* Area X = curb to curb x fulllength of the bridge.

### Sample of Worksheet for Deck Rehabilitation Removal Details 16.12 (C) -1

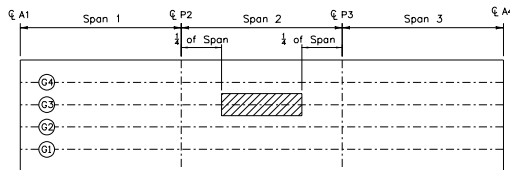


**PLAN**  
(For inside girders only.)

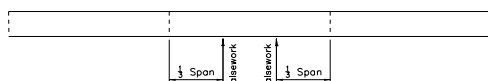
▨ Deck repair area at one side of the girder.  
▩ Deck repair at the other side of the girder.

Working on both sides of the same girder concurrently is not permitted.

#### DECK CONCRETE REPAIR WHEN FALSEWORK IS NOT REQUIRED

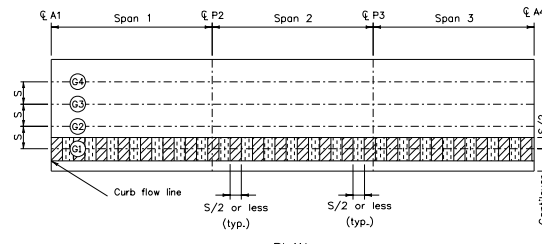


**PLAN**



**ELEVATION**

▨ Class 3 removal on both sides of a girder simultaneously within the middle half of a span.

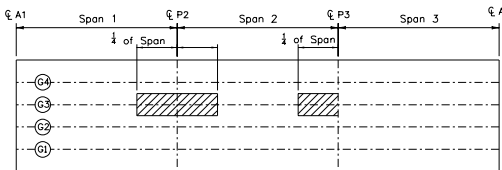


**PLAN**  
(For outside girders only.)

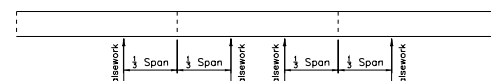
▨ Portions of deck sections removed simultaneously.  
▩ Portions of deck sections removed simultaneously.

Working on both portions concurrently is not permitted.

Note:  
S is defined as the center-to-center girder spacing. The Contractor shall be responsible for determining the girder spacing.



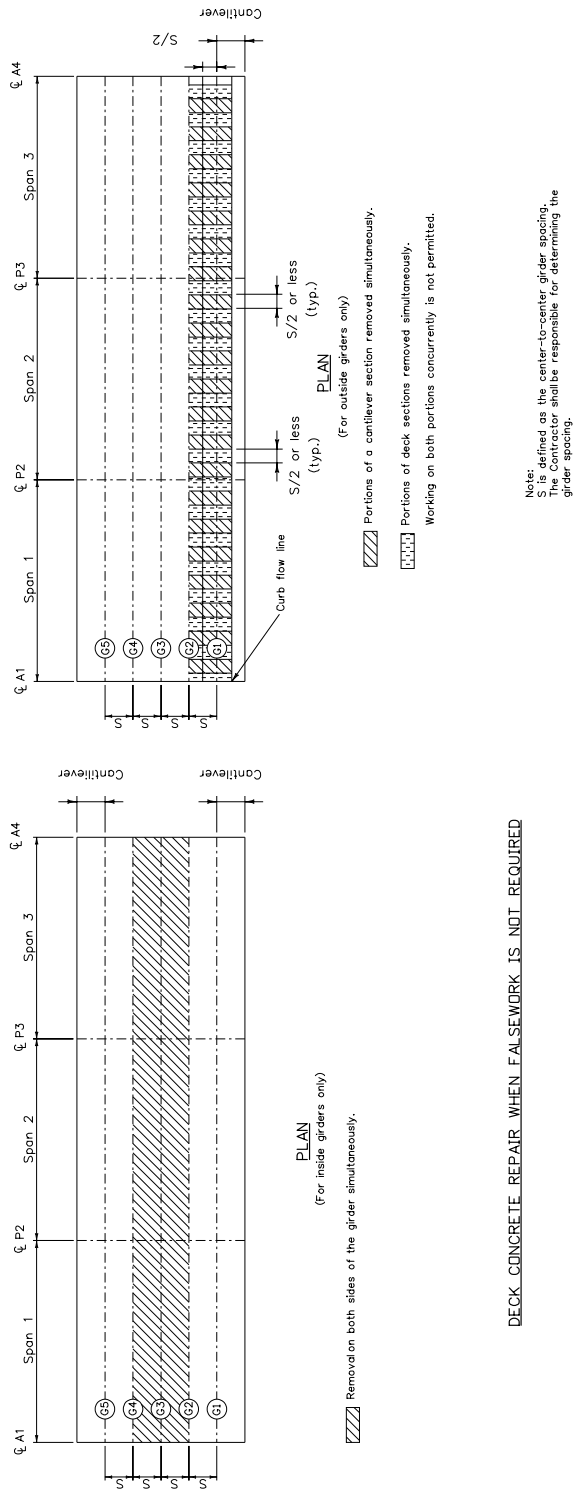
**PLAN**



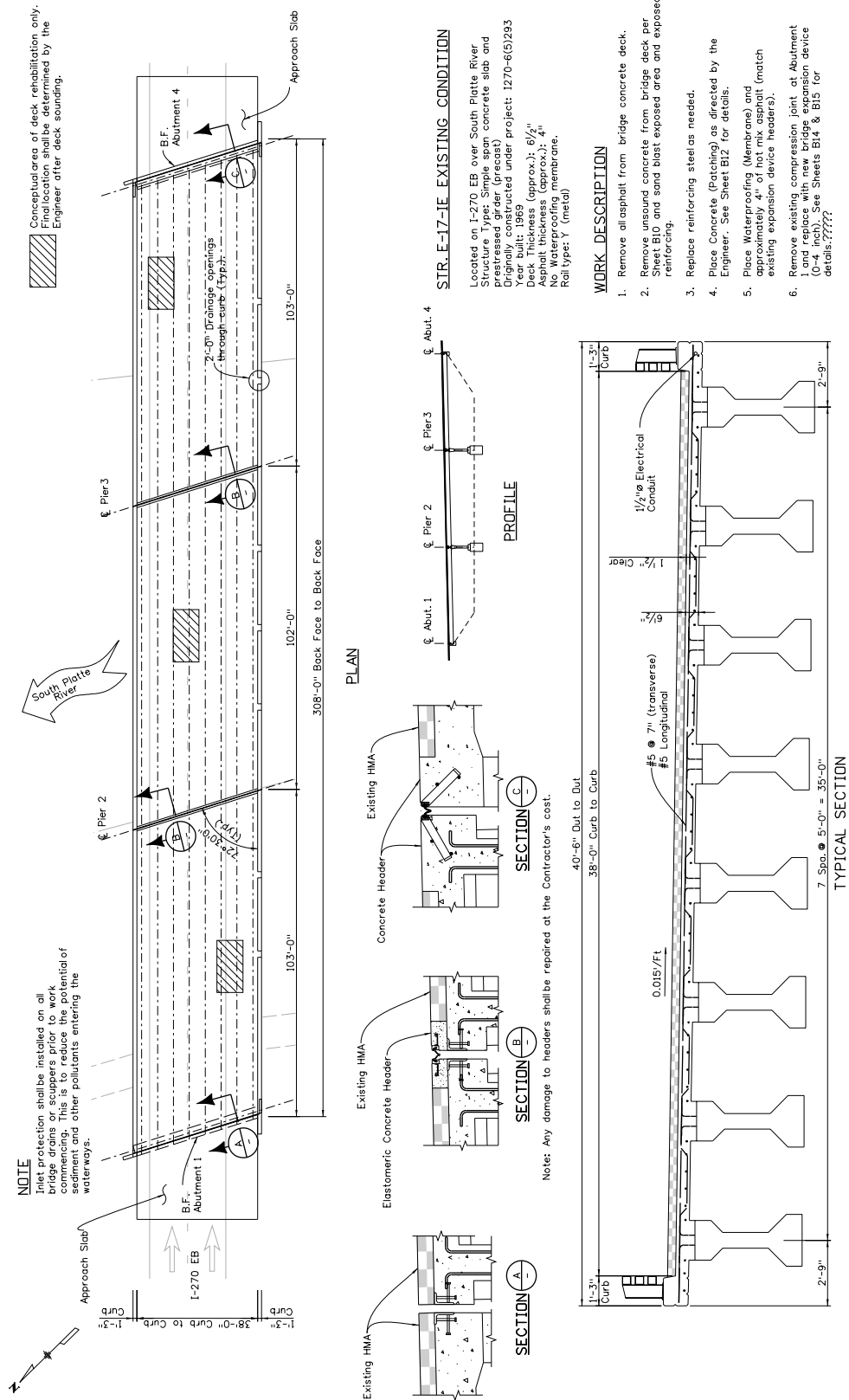
**ELEVATION**

▨ Class 2 or 3 removal on both sides of a girder simultaneously within the middle half of a span.

### Sample Phasing Details for Girders where Falsework may be required 16.12 (C) -2



DECK CONCRETE REPAIR WHEN FALSEWORK IS NOT REQUIRED



Sample Layout and Details for Deck Rehabilitation Project  
16.12 (C) -4



**Close-up Photo of Deck Rehabilitation  
16.12 (C) -5**



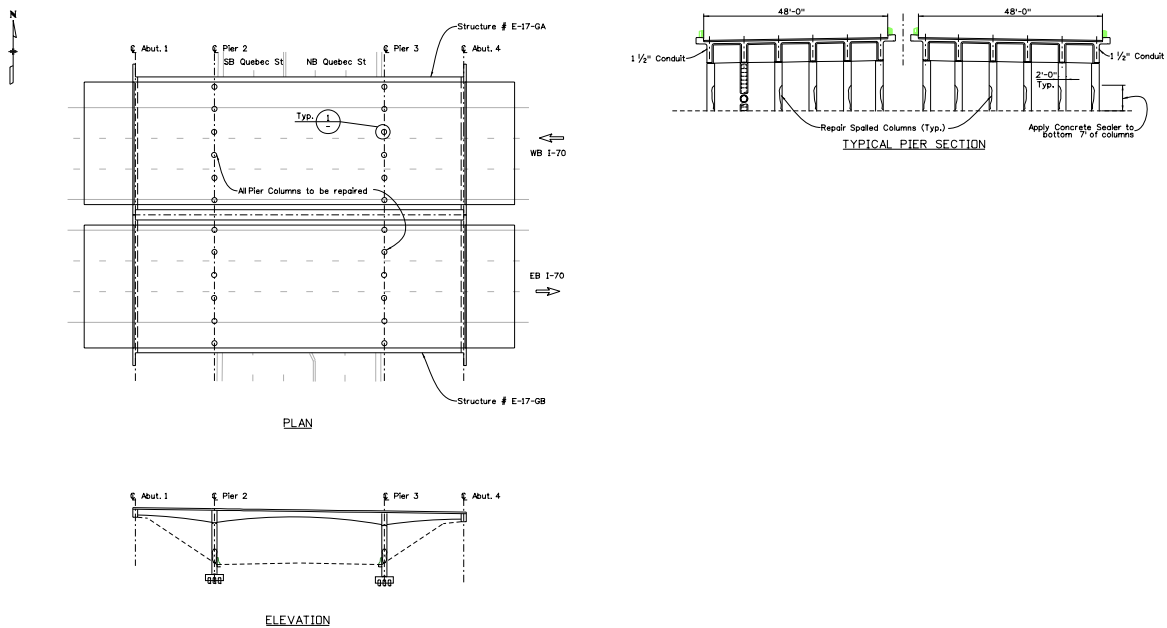
**Photo of Deck Rehabilitation (Removals approaching critical levels)  
16.12 (C) -6**

- (D) **Pier Cap and Column Repair** - These repairs are typically rehabilitation of column, abutment & pier damage due to water leakage or corrosive salts. Often they are done in conjunction with the addition of corbels. If possible, the source of leakage should be removed. Waterproofing/Sealing can extend the life of the repair. Sample repair details are shown in Figures 16.12(D)-1 through 6.

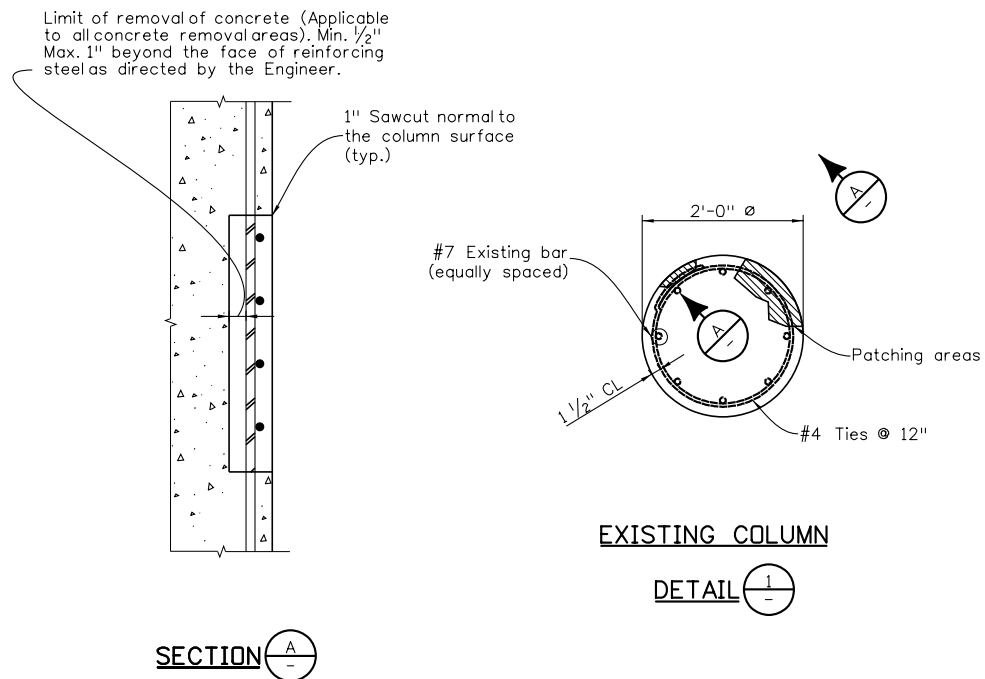
**Check Items:**

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts.

1. Approximate locations of repair.
2. Existing reinforcing, sizes and spacing
3. Amount of permissible loss from column prior to contacting Staff Bridge or providing temporary support.
4. Splicing details.
5. Repair details.
6. Rebar replacement details
7. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
8. Work Description.
9. Bridge Description.

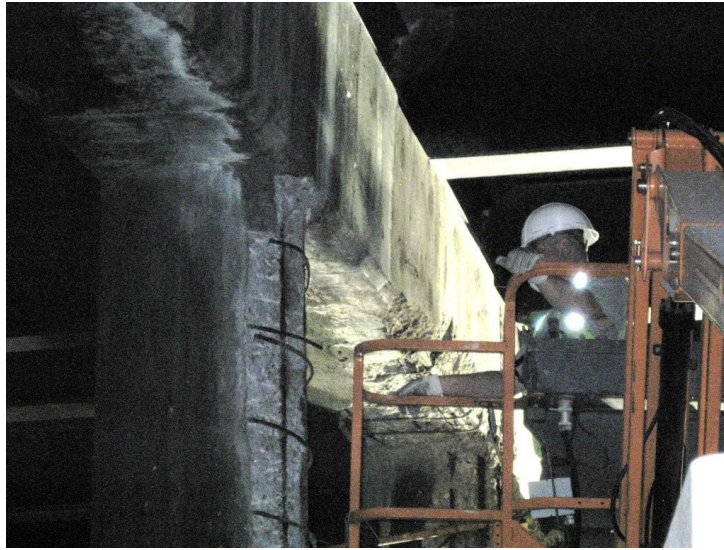


**Sample General Layout for a Pier Cap/Column Repair**  
**16.12 (D) -1**

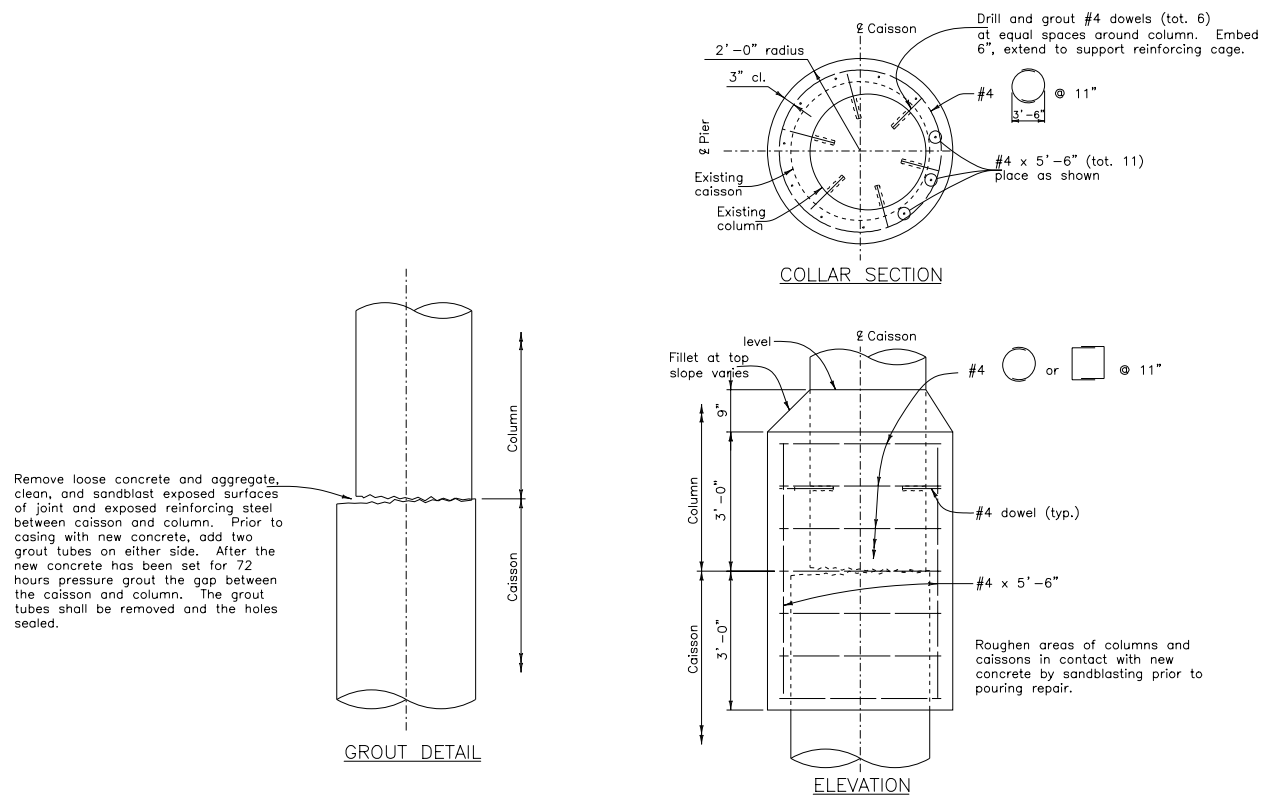


Note: Apply approved Concrete Sealer to all columns after patching repairs are complete per Manufacturer's recommendations.

**Sample Detail showing Removals and Patching**  
**16.12 (D) -2**



**Photos showing column damage and repair process**  
16.12 (D) -3

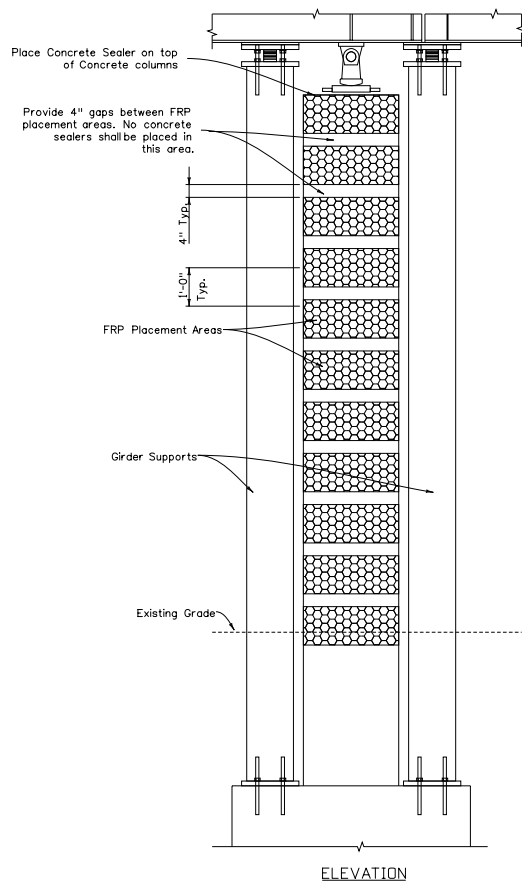


**Sample of Column Repair**  
16.12 (D) -4





Photo of Damage to be repair by (D)-4 details  
16.12 (D) -5



Sample of Fiber Wrap Details  
16.12 (D) -6



Photo of Fiber Wrap  
16.12 (D) -7

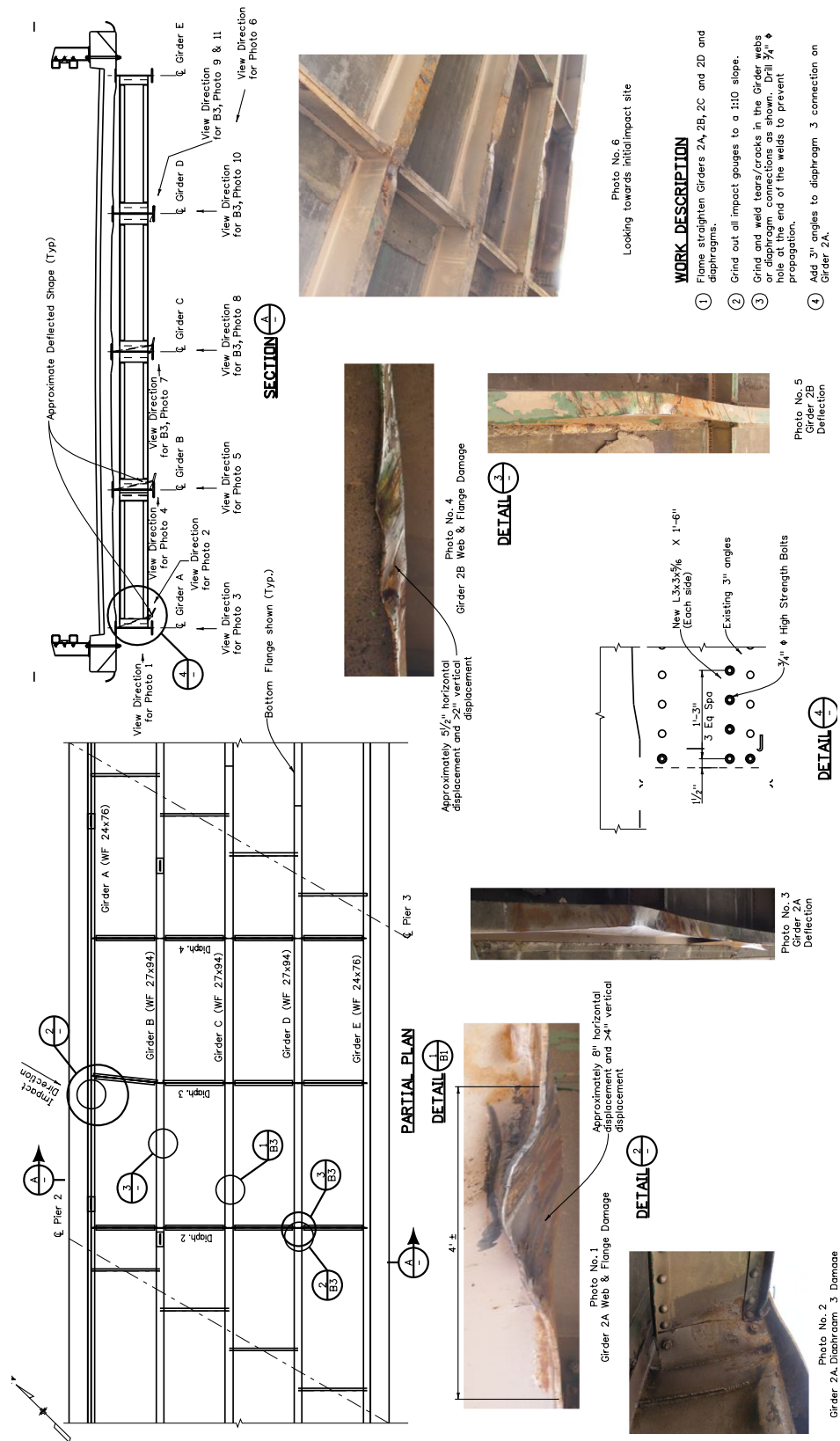


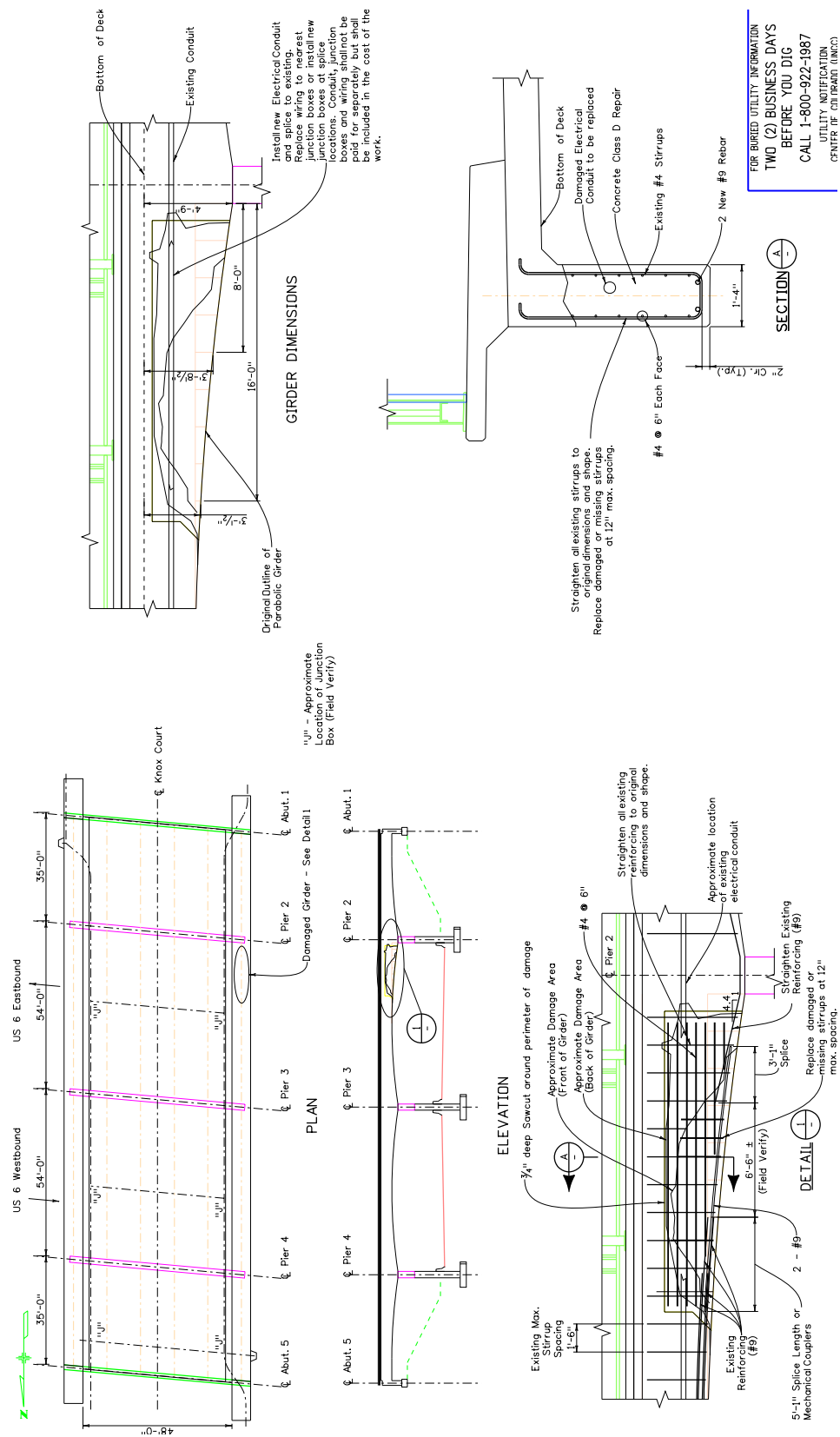
- (E) **Impact Repair** - These repairs are typically required due to high loads hitting and damaging the bridge girders. If the damage is not too severe for steel girders, flame straightening can often be used to bring the girder back to its original position although lead based paints can be an issue. Lead based paints or coatings should be addressed in the repair details. Provide appropriate specifications for dealing with the lead based coatings prior to the repair. Depending on the amount of damage to the girder, partial or full closure of the bridge may be necessary.

**Check Items:**

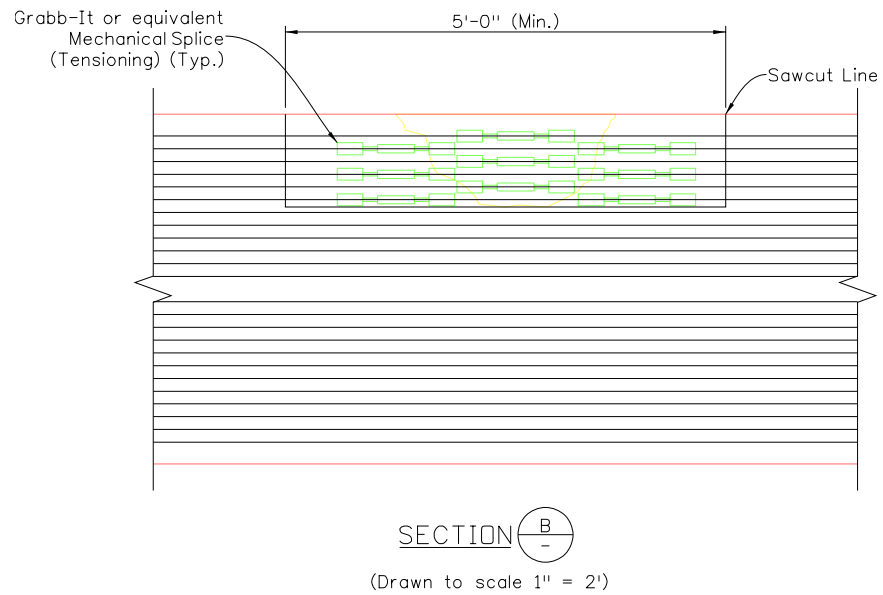
Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts.

1. Amount of impact deflection in steel girders
2. Approximate area of repair (Pictures may be used to depict the amount of damage but should not be the sole description.)
3. Layout, girder spacing & typical section.
4. Grade of steel.
5. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
6. Specifications for Hazardous Coatings.
7. Work Description.
8. Bridge Description.

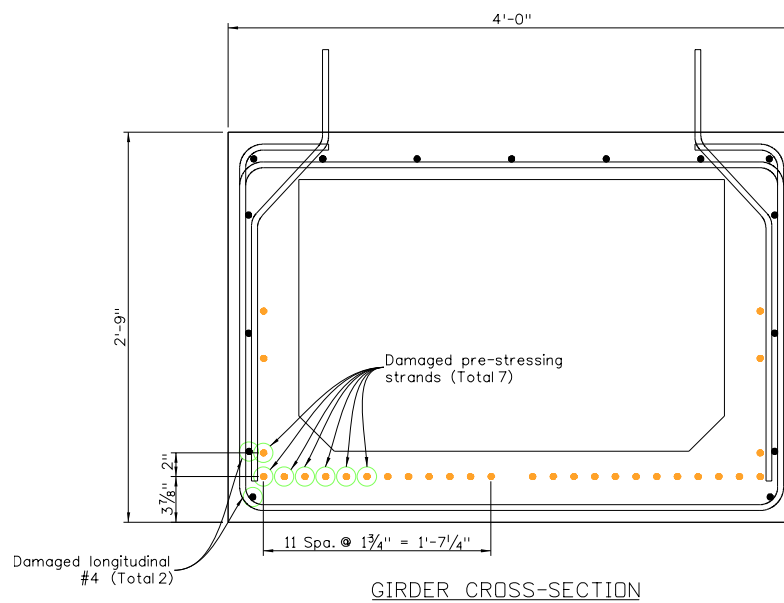




Sample Plan of Concrete Tee Girder Repair  
16.12(E)-2



**Sample Section of Precast Prestressing Repair  
16.12 (E) -3**



**Sample Section of Precast Girder Repair  
16.12 (E) -4**



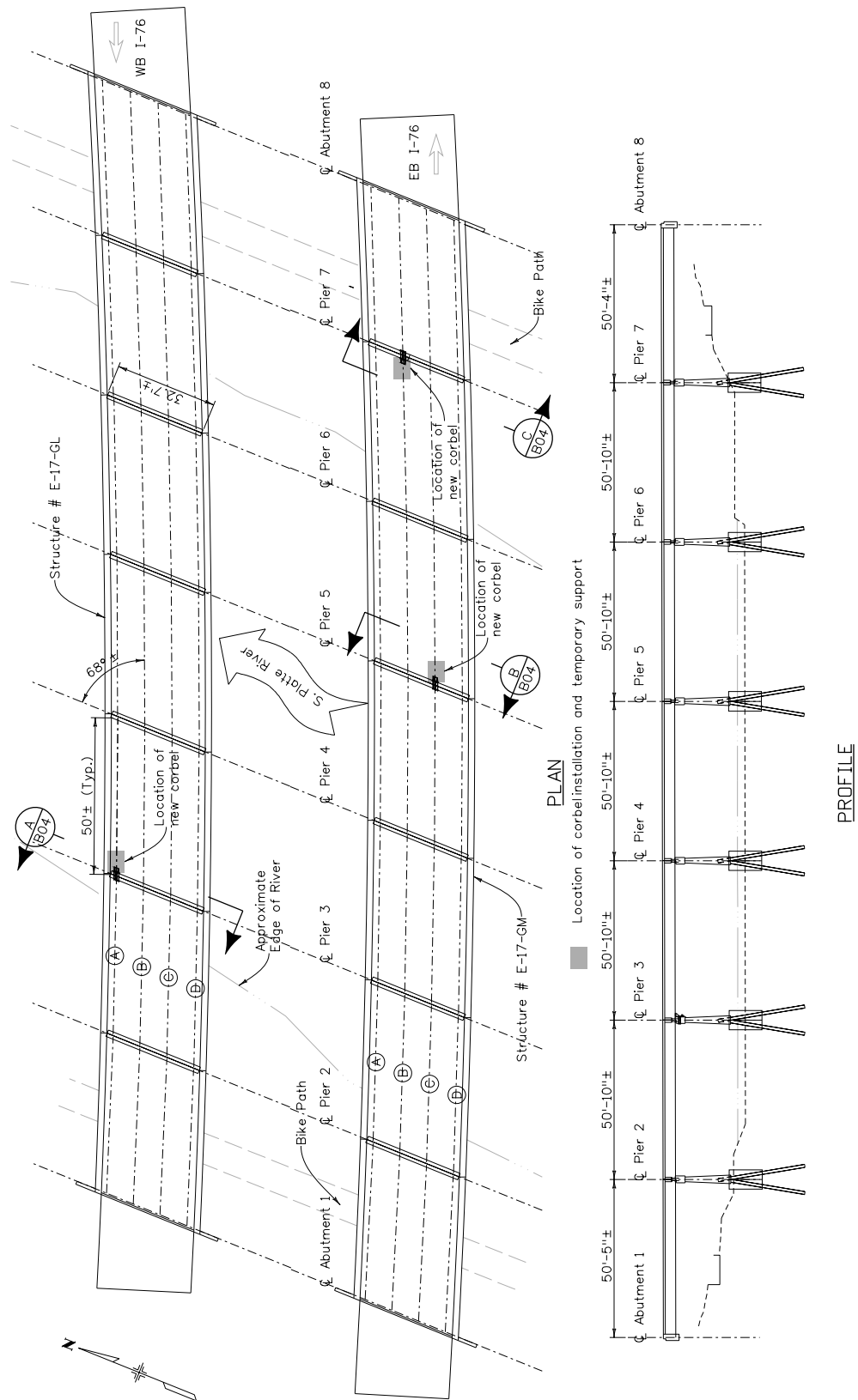
**Photo of Precast Girder repair in progress  
16.12 (E) -5**

**(F) Corbel Placement** - These repairs are typically requested by Bridge Inspection when the amount of girder bearing has been significantly reduced. Corbels could be considered as permanent falsework, but are considered more of a secondary support. If the loss or removal area for the pier or abutment patching is greater than ~33% of the bearing area, temporary supports will probably be required during pier repair and corbel installation. In some cases, the temporary support may be able to be used for a more permanent support, e.g. pier straddle supports. See Section (I) for sample falsework details.

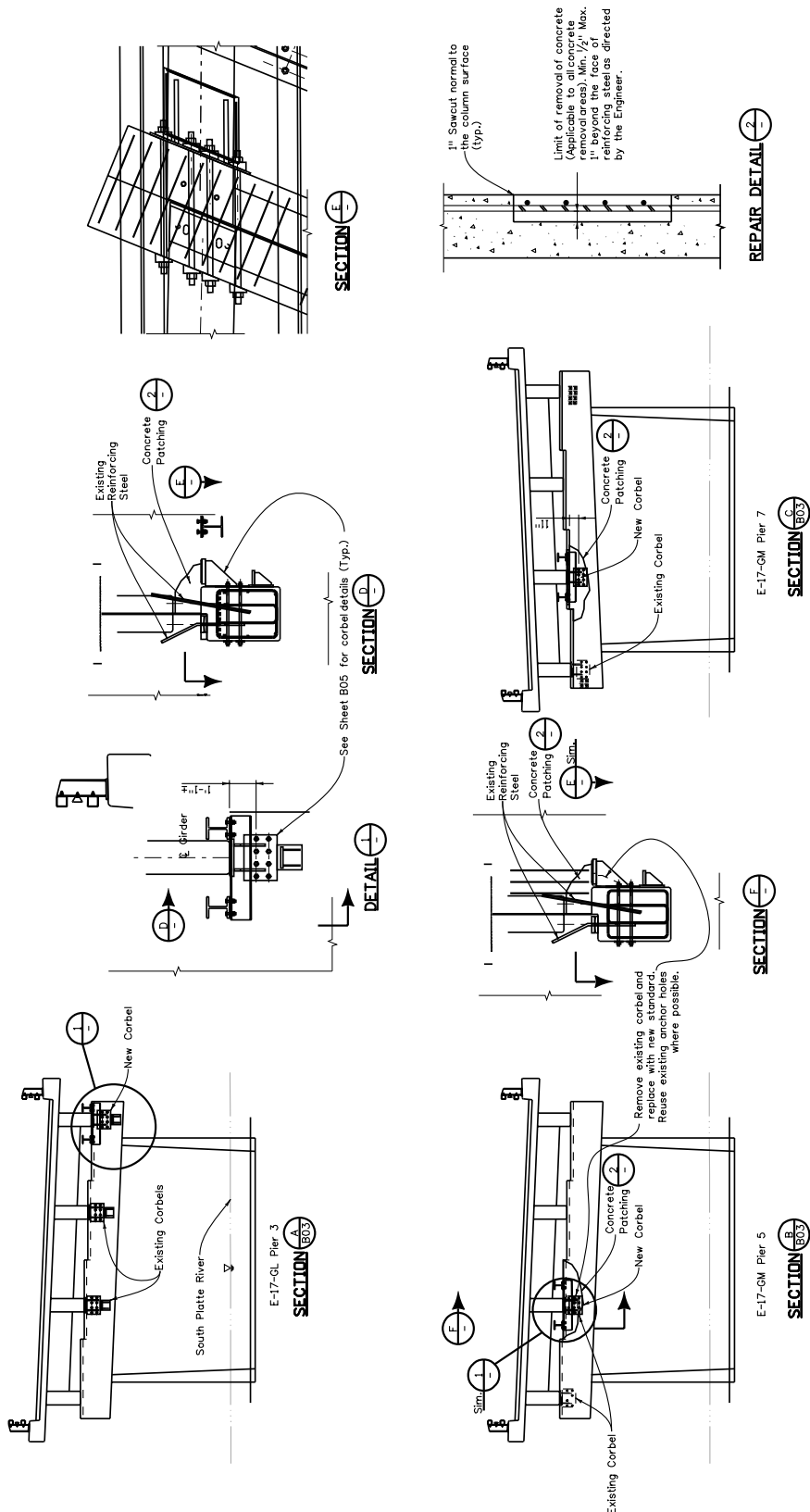
**Check Items:**

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts. In addition, constructability and "fit" of supports will be checked (see Section I)

1. Conflicts with existing reinforcing and/or resolutions.
2. Location of bolt pattern.
3. Skew angle and angle of corbel if different than skew.
4. Dimension from top of cap to bolt layout
5. Width of Pier Cap
6. Copy of the existing plans or enough details to depict reinforcing & conflicts clearly.
7. Temporary support details as required (See Section I).
8. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
9. Work Description.
10. Bridge Description.



Sample Plan for Corbel Placement  
16.12(F)-1



Sample Sections and Elevations for Corbel Placement  
16.12(F)-2



**GENERAL NOTES:**

Design lengths below assume a CSG structure type carrying a 20-44 loading with an 8'-deck and 4' of asphalt.

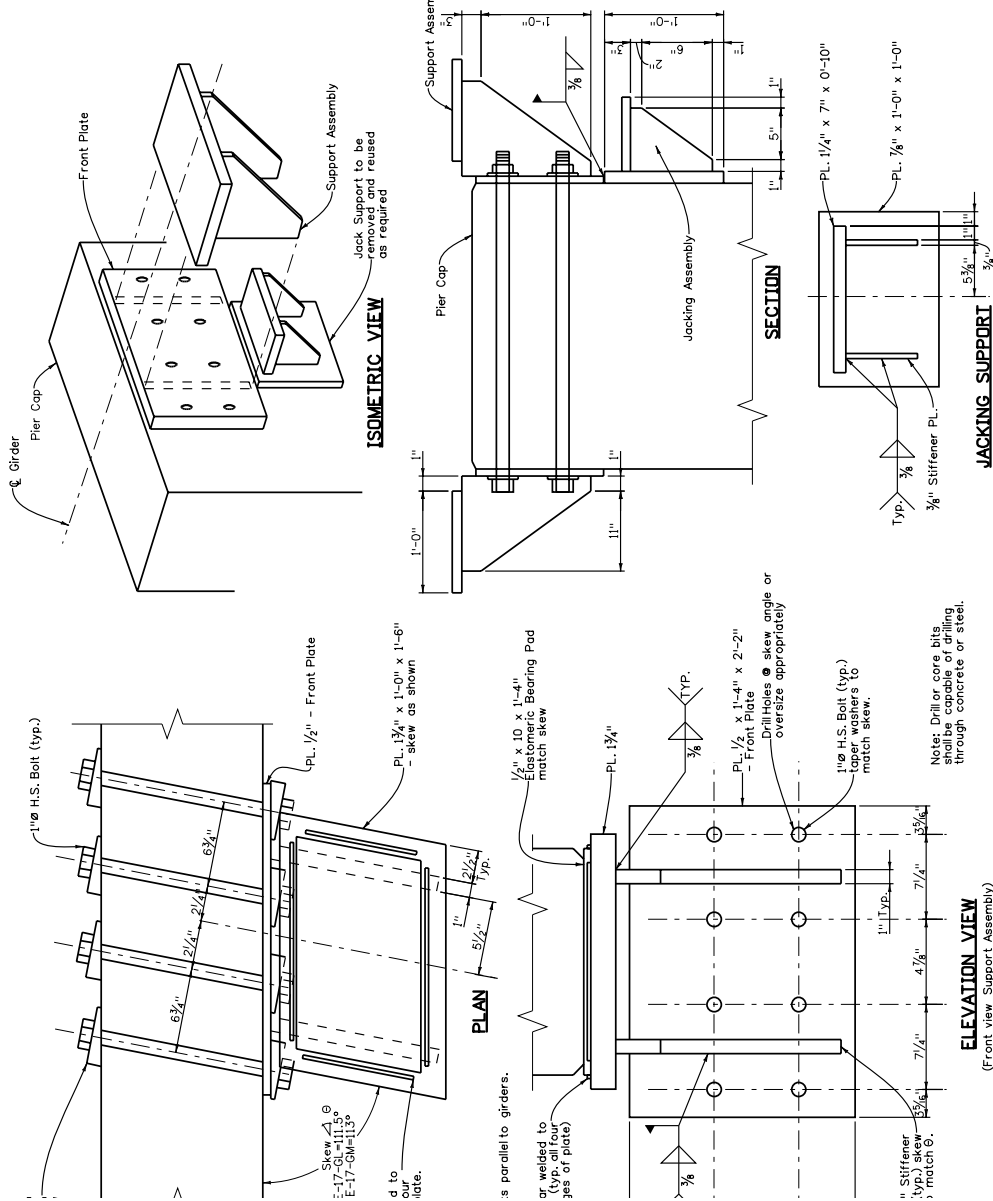
Note: where repair is required on both sides of pier cap, the repair shall be done on both sides of the bearing assembly on both sides as shown in the section.

All bolts shall be A449 high strength bolts.

The Contractor shall verify all dimensions prior to ordering materials

**SUGGESTED CONSTRUCTION PROCEDURE**

1. Locate and mark centerline of the girder on the pier cap.
2. Mark location of bolt holes on pier cap, see elevation view and section.
3. Drill holes in pier cap and place bolts.
4. Cut holes in plywood form to match bolt holes in pier cap.
5. Remove loose concrete and clean reinforcing steel.
6. Bolt the form in place and restore the pier cap using approved grout (Duracast, etc.).
7. Allow curing time as recommended by the manufacturer before removing the form.
8. Using the form for a pattern, cut the bolt holes in the front plate.
9. Attach plates and tighten bolts. (100 lb-ft. Torque).
10. Raise the support assembly until the elastomeric pad is compressed  $\frac{1}{8}"$  (200 psi x pad area = jacking force).
11. Field weld the support assembly to the front plate.
12. Paint all steel as directed by the Engineer



Sample Worksheet for Corbel Placement Details  
16.12 (F)-3



**Photo of Corbel Placement and Pier Cap repair  
16.12 (F) -4**



**Front Side of Corbel  
16.12 (F) -5**



**Back Side of Single Corbel  
16.12 (F) -6**

- (G) **Timber Pile Repair** - Typically timber piles need repair due to rotting or insufficient diameter. Repairs include replacing decomposed areas with timber, concrete encasing, or adding supports or bracing.

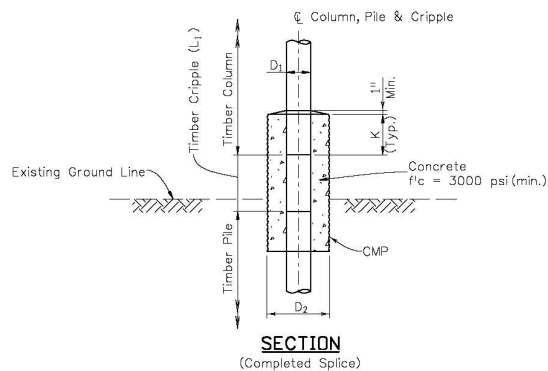
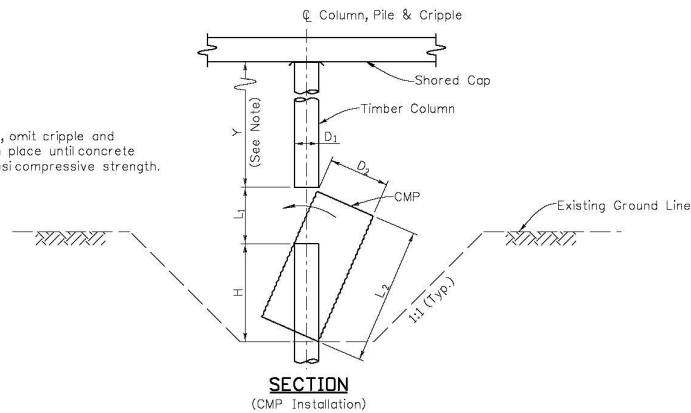
**Check Items:**

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts and to confirm applicability.

1. Location of damaged column
2. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
3. Work Description.
4. Bridge Description.

**NOTE:**

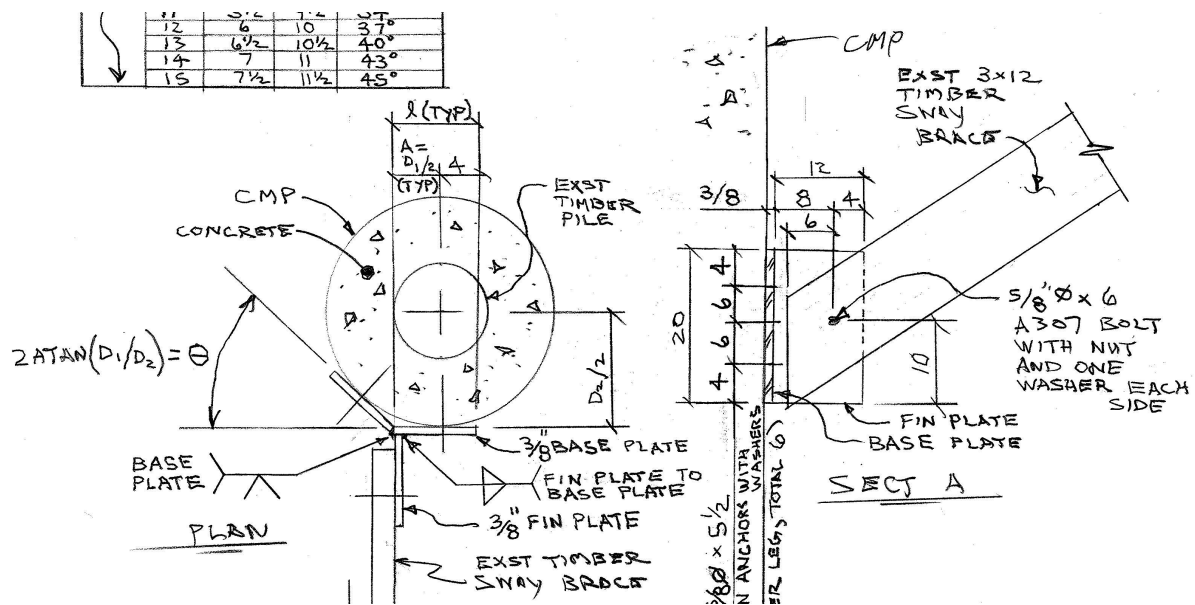
If  $Y < L_2 + 6"$ , omit cripple and leave shoring in place until concrete reaches 2100 psi compressive strength.



**Sample Repair Detail for a Timber Pile/Column Repair  
16.12 (G) -1**



Photo of Timber Pile/Column Repair in progress  
16.12 (G) -2

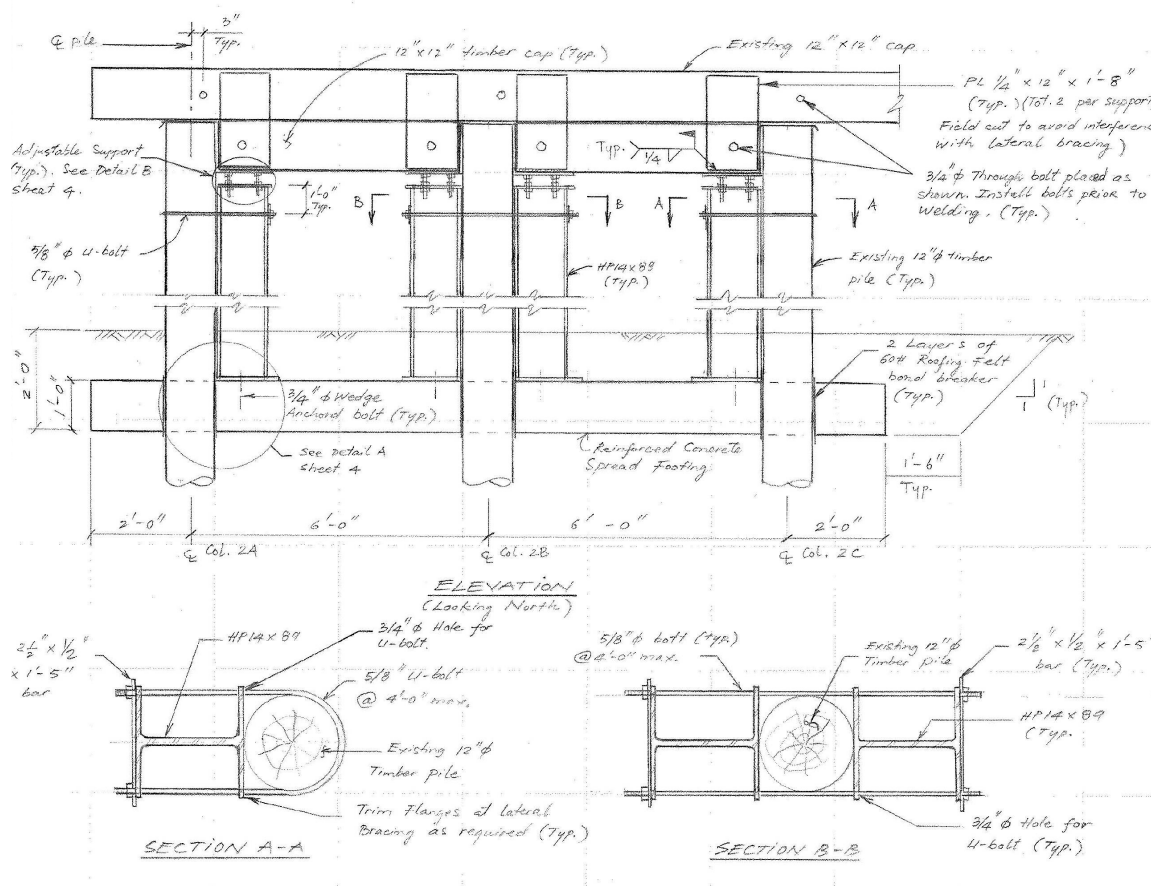


Sample Detail of Timber Pile Repair and Bracing  
16.12 (G) -3



**Photo of Timber Pile Repair and Bracing Connection  
16.12 (G) -4**





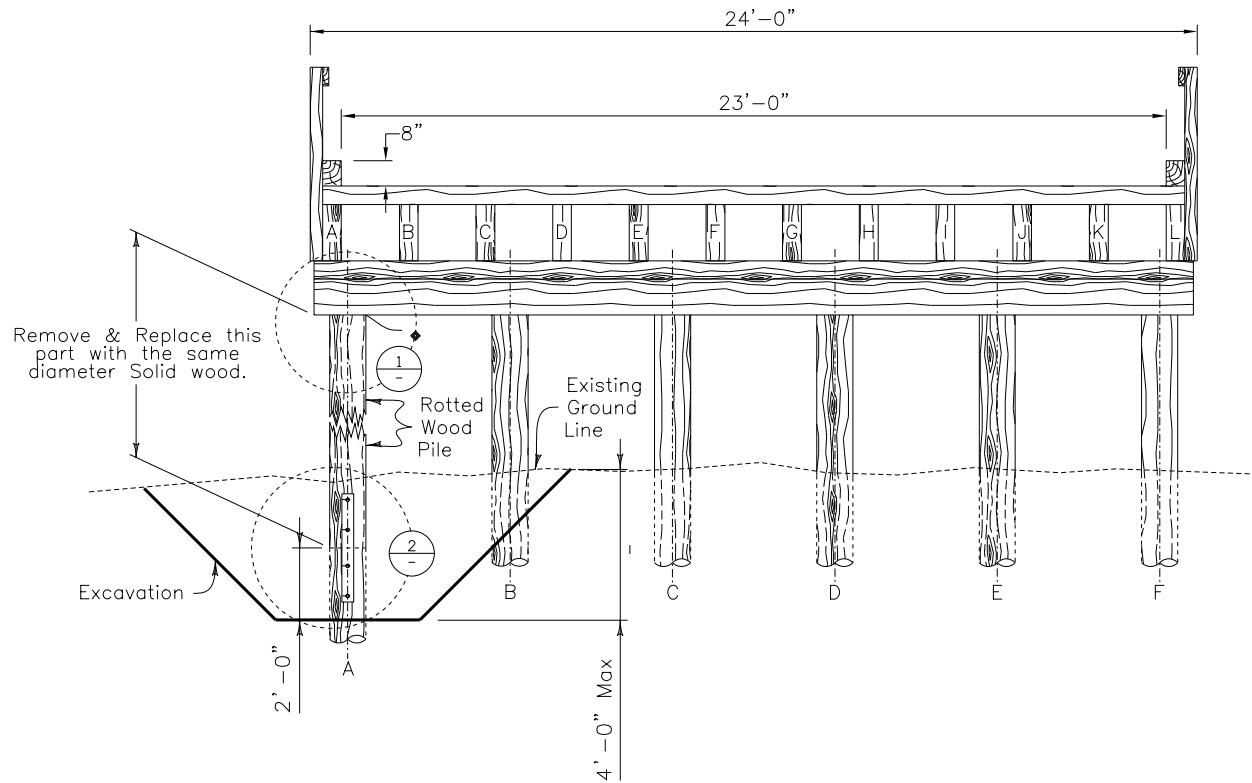
Sample of Adding Columns to a Pile

16.12 (G)-5

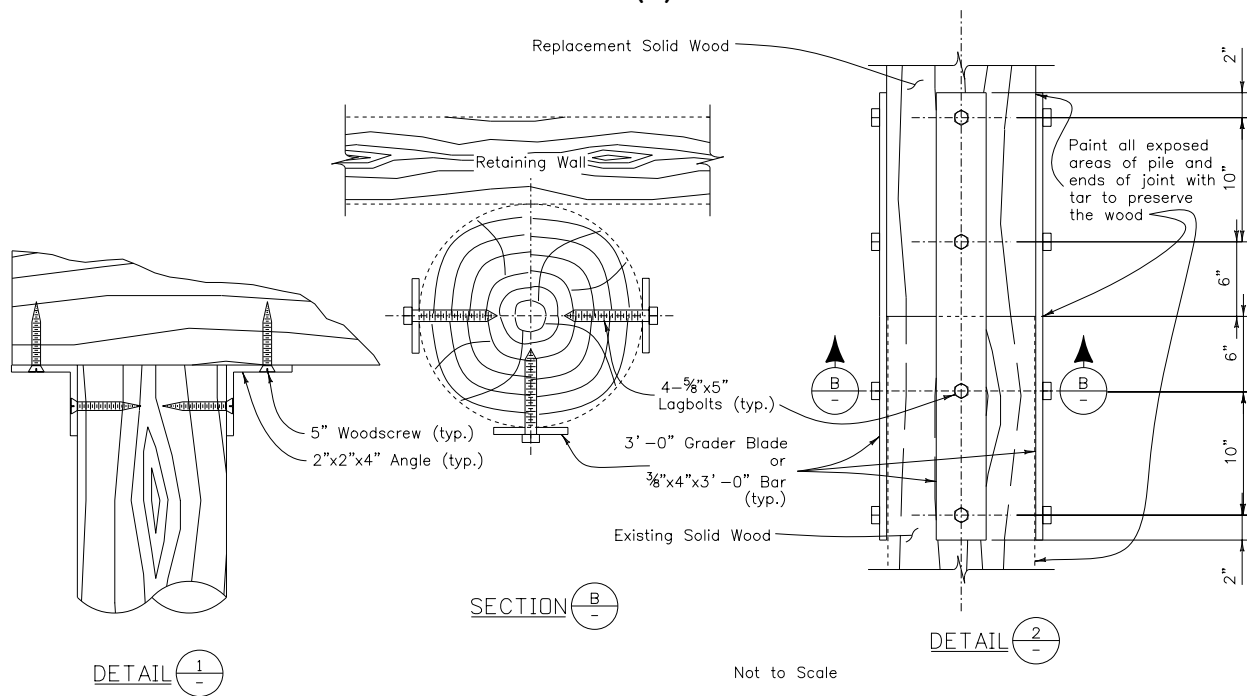


Photo of Adding Columns to a Pile

16.12 (G)-6



**Sample Section of Replacing Portion of Timber Pile  
16.12 (G)-7**



**Sample Details of Replacing Portion of Timber Pile  
16.12 (G)-8**

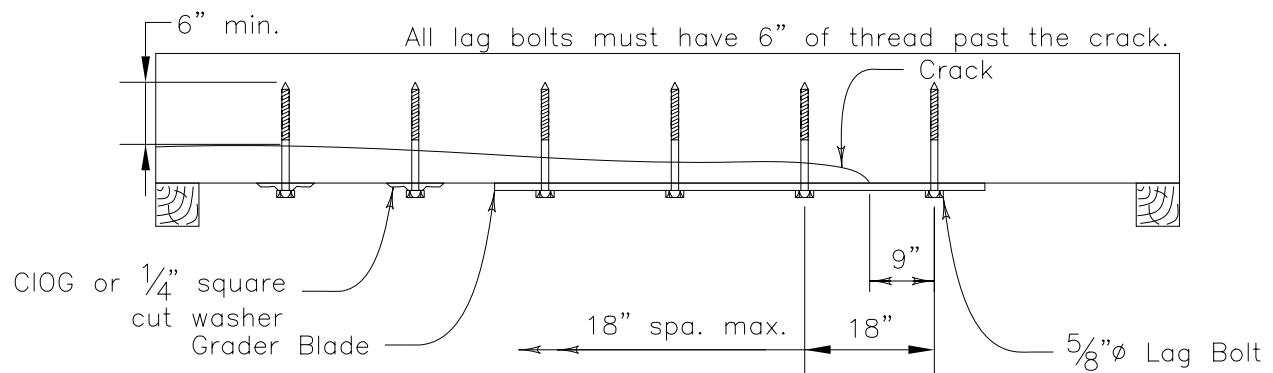
- (H) **Timber Bridge Girder Repair** - Typically Bridge Girder repairs are necessary when girders split or have deficient ratings. Some repairs include bolting split girders, adding new bents or adding additional girders. New bents may be of timber construction or steel construction.

**Check Items:**

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts as well as to confirm applicability.

1. Location of damaged girders.
2. Lag bolts in cracked stringer, attachment of snow plow or grader blades, false bents, etc.
3. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
4. Work Description.
5. Bridge Description.

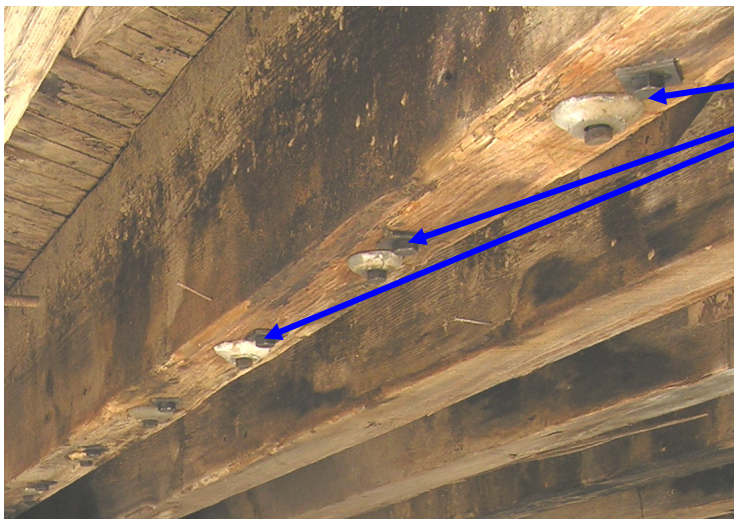




Repair Girder(s): \_\_\_\_\_

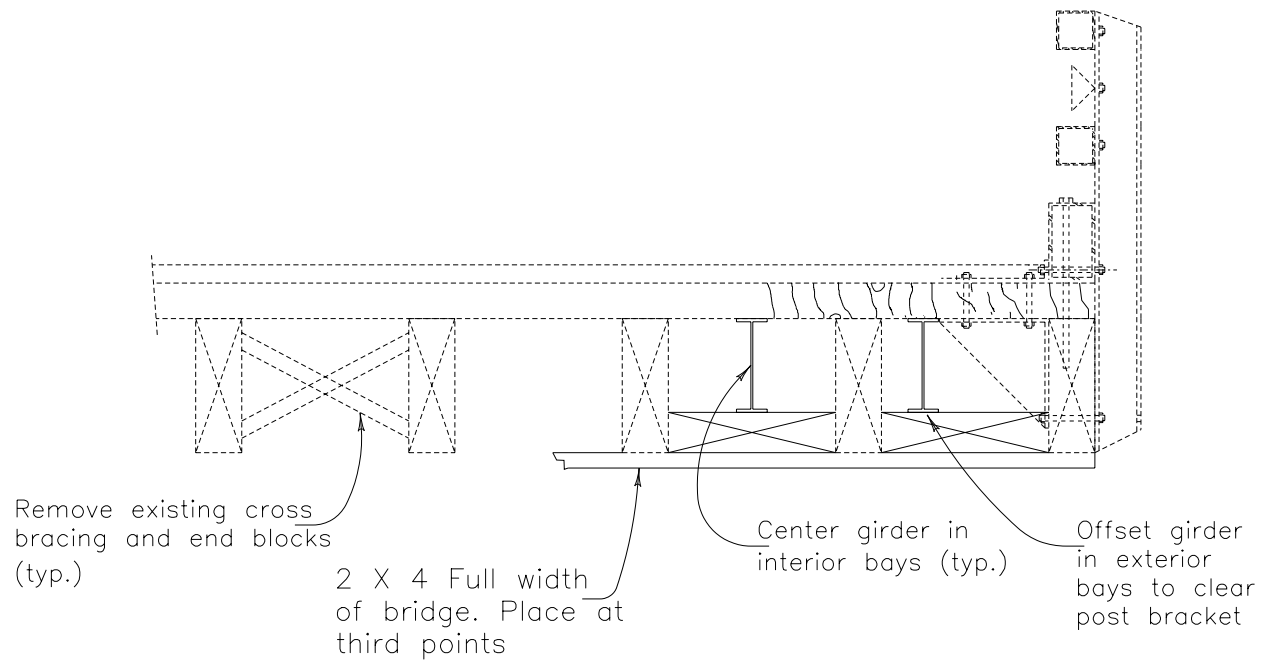
1. Lag bolts require prebored lead holes.
2. 5/8"Ø lag bolts require 5/8" Ø hole for the shank and 5/16" Ø hole for the threaded portion.
3. Lag bolts shall be inserted by turning with a wrench. Driving with a hammer is not acceptable.
4. Soap or other lubricant may be used to facilitate insertion.
5. CLOG and 1/4" square cut washers are interchangeable, but one must be under each lag bolt.

**Sample Repair of Timber Girder with Lag Bolts**  
**16.12 (H) -1**



Lag Bolts

**Photo of Repaired Timber Girder with Lag Bolts**  
**16.12 (H) -2**



### PART SECTION

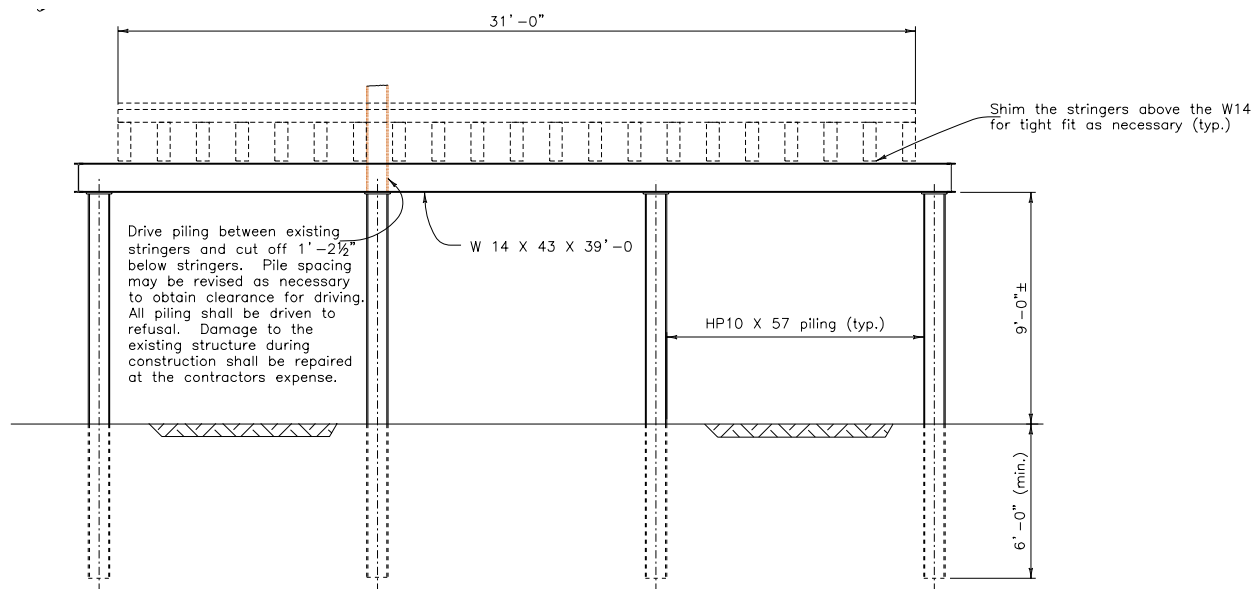
**Sample Section of adding steel girders to a Timber Bridge**  
**16.12 (H) -3**



**Photo of steel girders added to a Timber Bridge**  
**16.12 (H) -4**



**Photo of Added Steel Girder and Grader Blade on Timber Girder  
16.12 (H) -5**



**Sample Section showing additional Bents  
16.12 (H) -6**





Photo of New Support Bent near Abutment  
16.12 (H) -7



Photo of New Support Bent at Midspan  
16.12 (H) -8



Photo of New Timber Bent  
16.12 (H) -9

- (I) **Falsework** – Falsework may be required to support a bad deck or may be required to support a girder, etc. during repair work. A conceptual idea should be presented as a minimum.

**Check Items:**

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts. In addition, constructability and “fit” of supports will be checked.

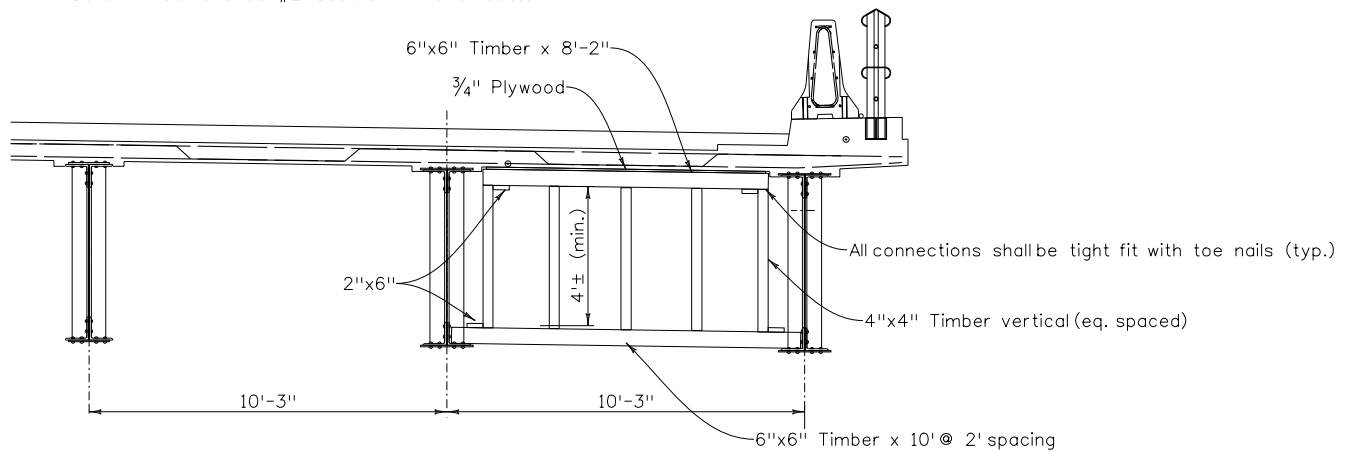
1. Location, grade, size and spacing of timber or other material as required. Timber is typically used because of weight and availability issues.
2. Provide typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
3. Work Description.
4. Bridge Description.
5. Construction details as required.

Timber Notes:

All timber dimensions are nominal.

6"x6" Timber shall be #1 Southern Pine or better.

Other Timber shall be #2 Southern Pine or better.



**Sample Section of Falsework to support a deck  
16.12 (I) -1**



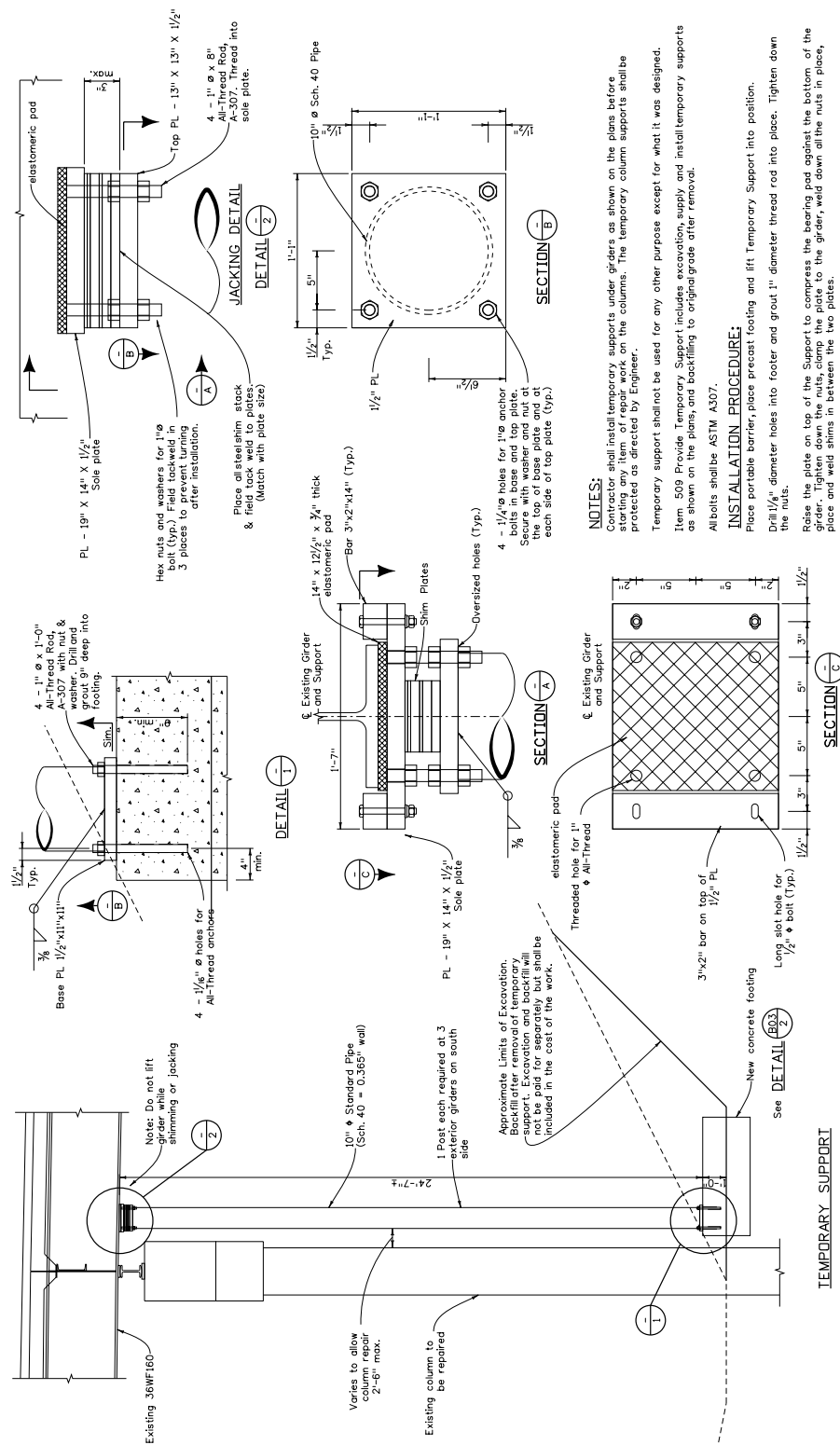
**Photo of Deck Falsework  
16.12 (I) -2**





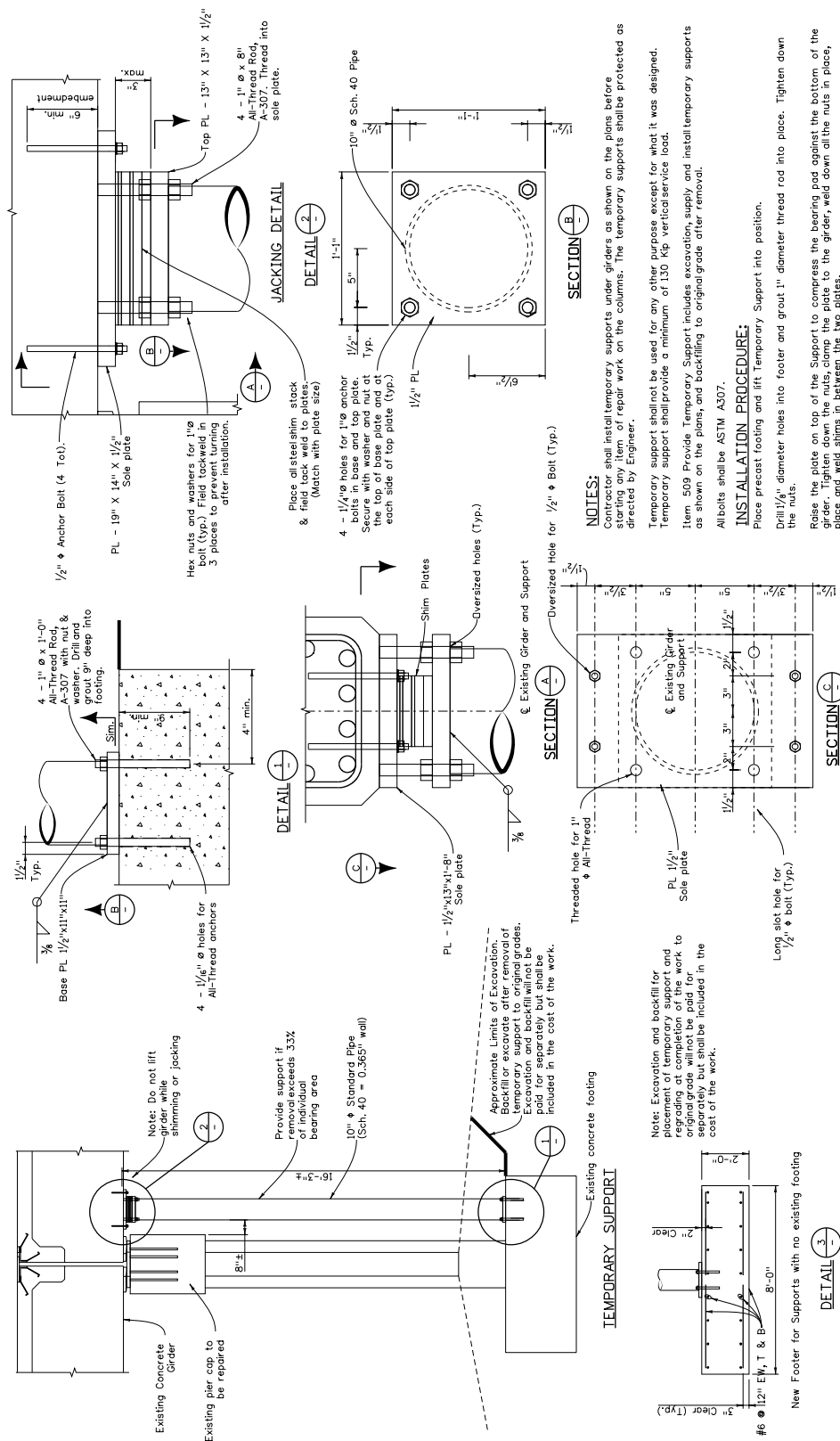
Photo of Falsework to support a steel girder  
16.12 (I) -3



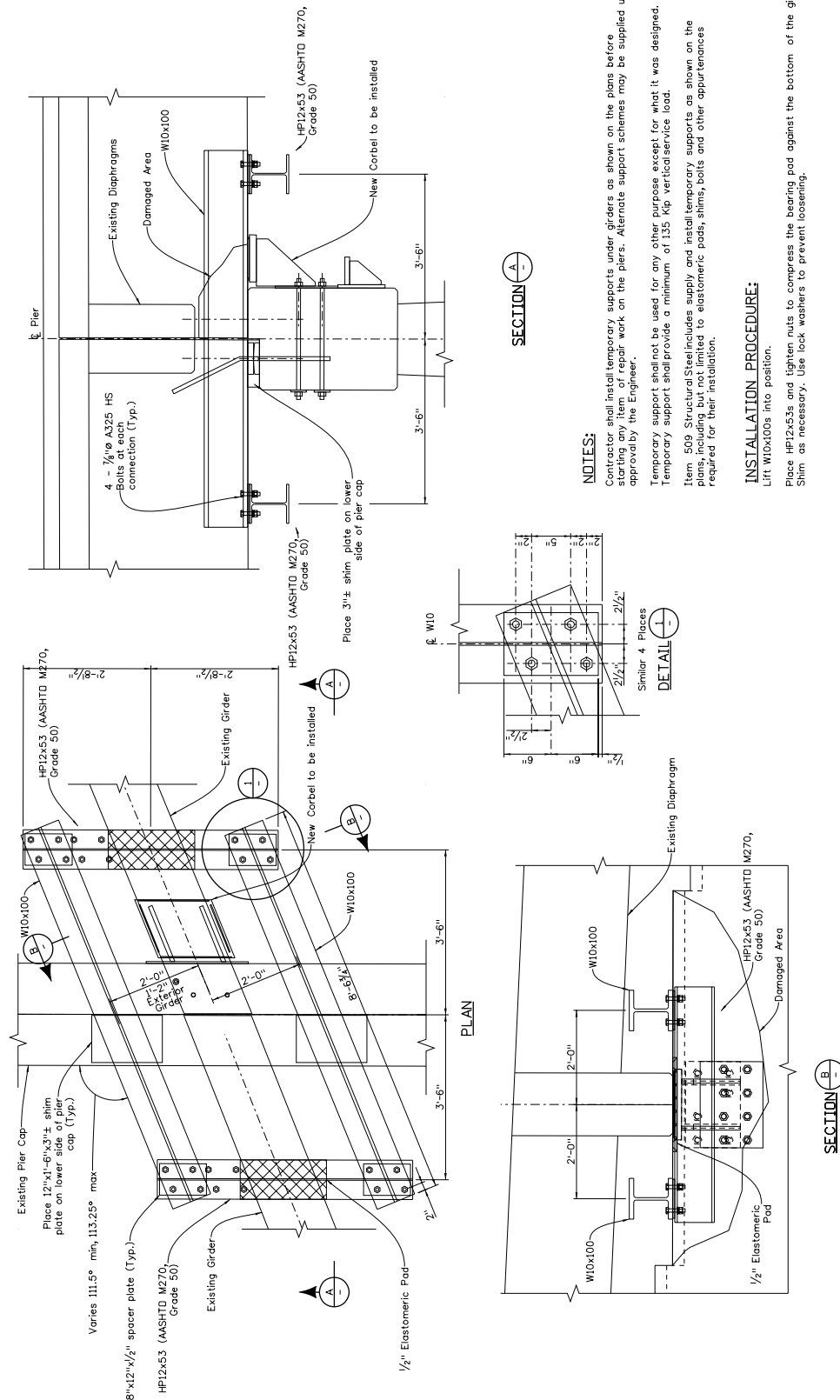


### Sample Details for Falsework to Support a Steel Girder

16.12 (I) -4



Sample Details for Falsework to Support a Concrete Girder  
16.12(I)-5



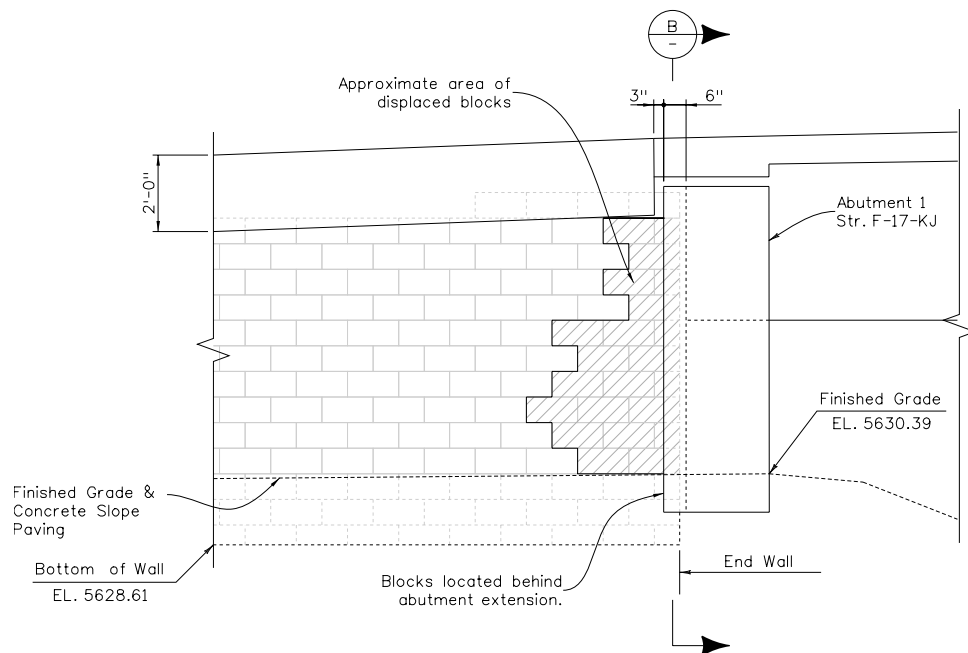
Sample Details of Straddle-Type Falsework  
16.12 (I) - 6

- (J) **Wall Repair** - These repairs typically include the strengthening or repairing of existing walls where replacement is not practical.

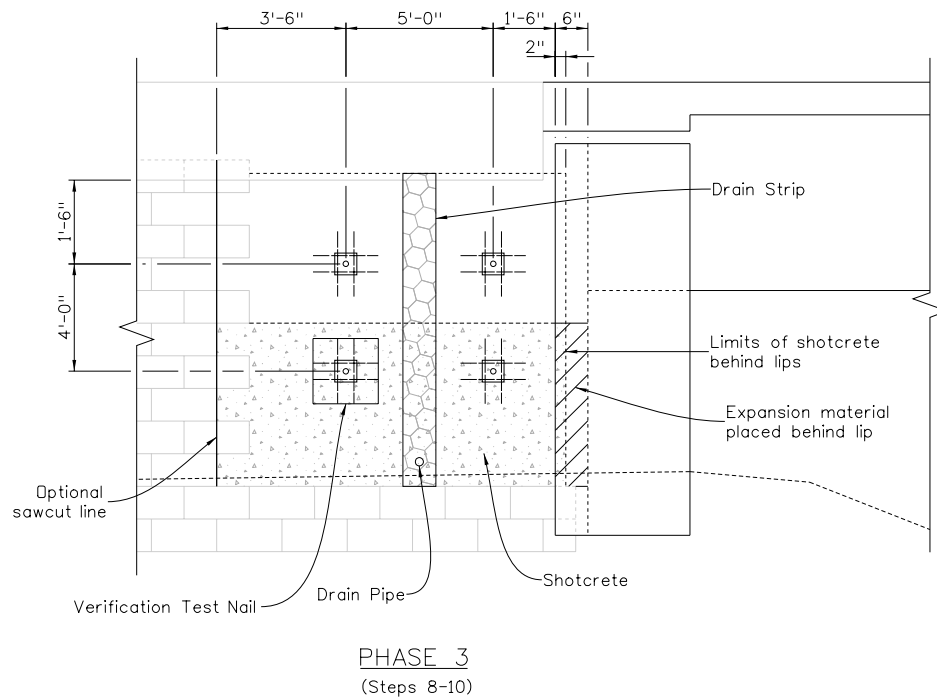
**Check Items:**

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts.

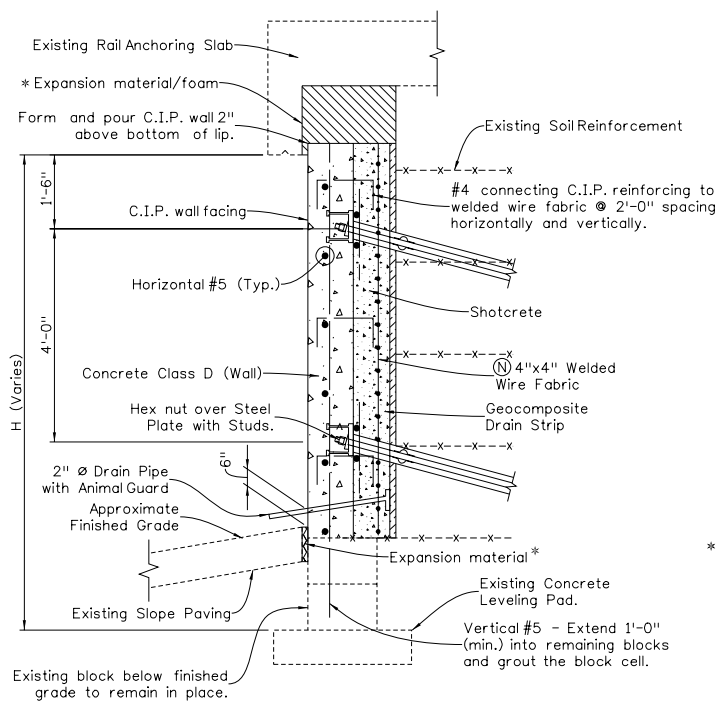
1. Location and extent of repair.
2. Utility conflicts, etc. that will affect the work.
3. Phasing as required.
4. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, bridge constraints, etc.
5. Work Description and Construction Sequence.
6. Bridge and/or Wall Description.



**Sample Elevation of Area to be repaired on a MSE Wall  
16.12 (J)-1**



**Sample Soil Nail Details on MSE Repair  
16.12 (J) -2**



**NOTE:**

\* Expansion material/foam is to be placed everywhere needed to keep the new wall independent from the abutment, rail anchoring slab, and slope paving. Low Density Polystyrene material is acceptable for expansion material.

**SOIL NAIL WALL SECTION**

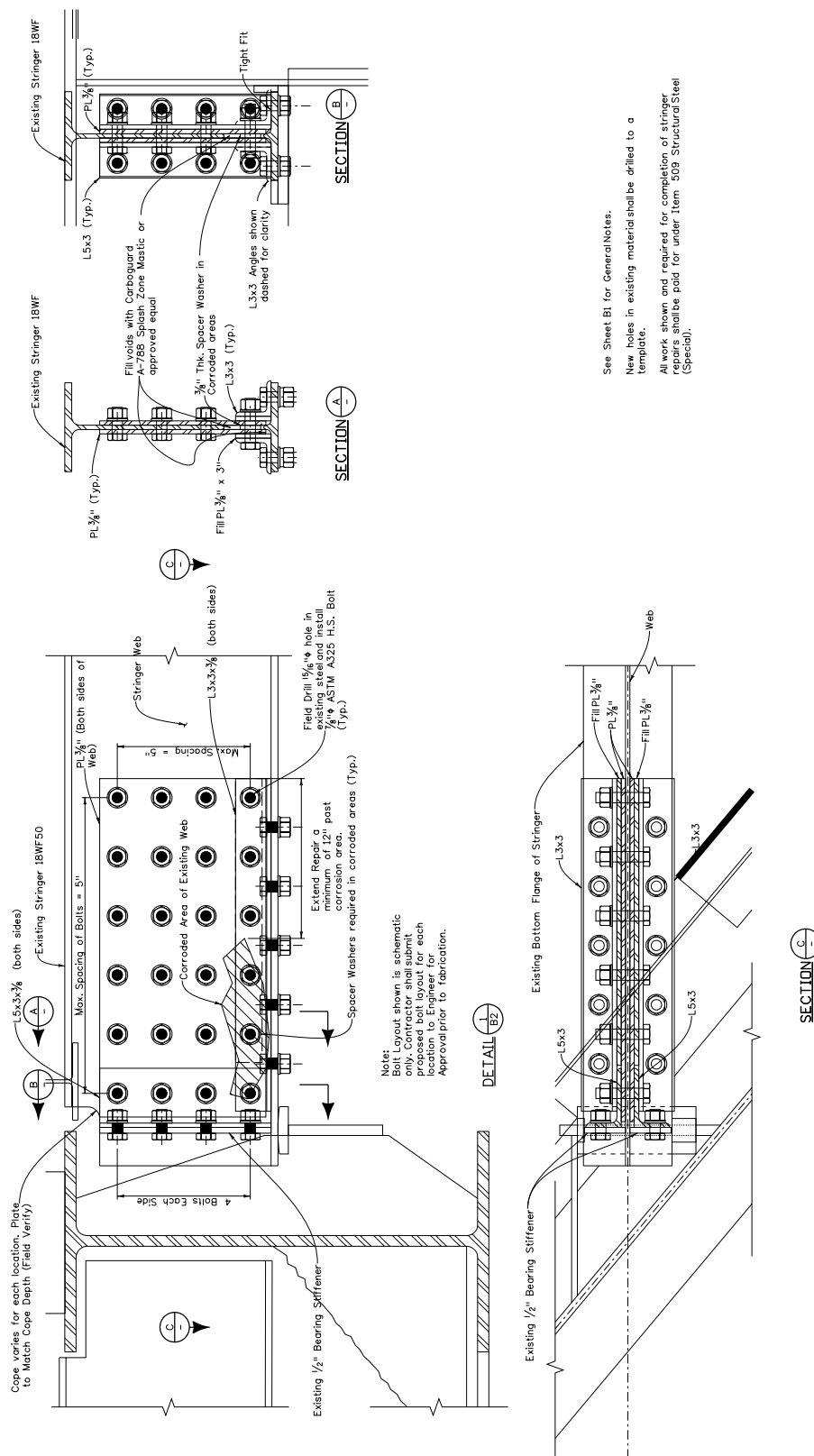
**Sample Soil Nail Section for MSE Repair  
16.12 (J) -3**

- (K) **Steel Corrosion/Fatigue Repair** – These repairs typically include adding additional steel plates or rewelding problem structures. Lead based paints or coatings should be addressed in the repair details. Provide appropriate specifications for dealing with the lead based coatings prior to the repair. Some repairs can be accomplished with a written description or welding procedure.

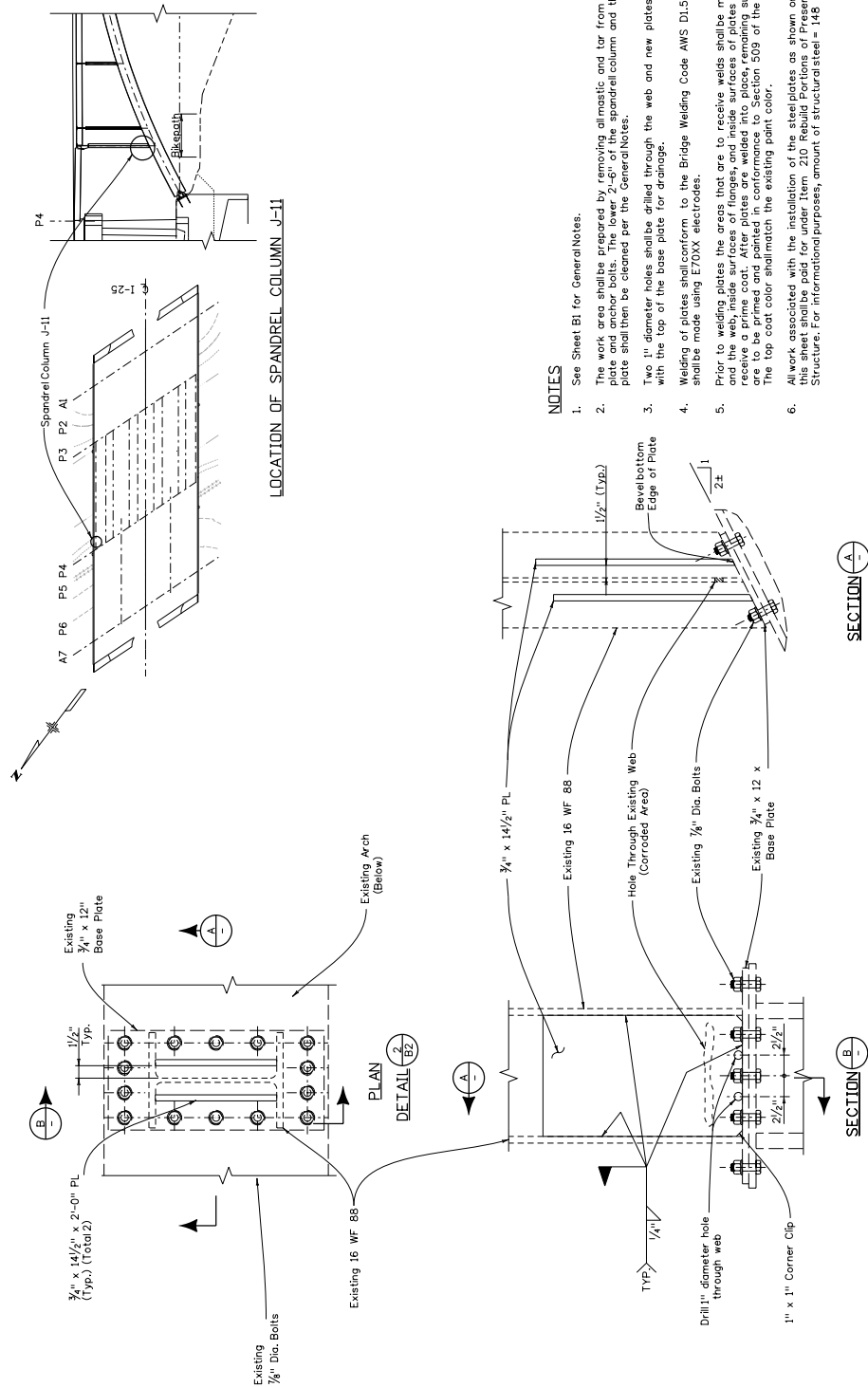
**Check Items:**

Following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. The detailer will make a field visit prior to FOR to verify as-built locations and conflicts and to confirm applicability.

1. Location and extent of repair.
2. Welding design and procedure per AWS D1.5 and/or D1.1.
3. Location of damaged areas.
4. Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
5. Specifications for Hazardous Coatings.
6. Work Description.
7. Bridge Description.

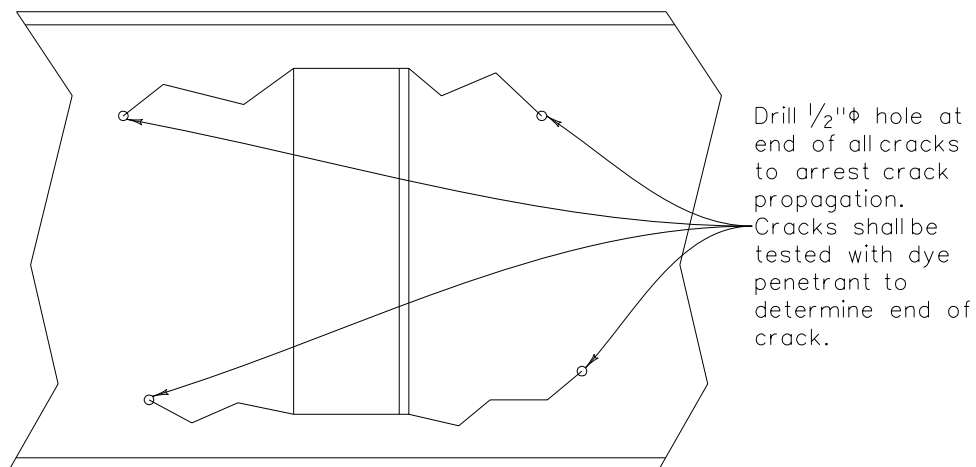


**Sample Details for Adding Steel Plates to a Corroded Girder**  
**16.12 (K) -1**



Sample Details for Repairing/Strengthening a Corroded column  
16.12 (K) -2





**Sample Detail of Drilling Holes at the end of Fatigue Cracks**  
**16.12 (K) -3**

Repair procedure welding, testing, and inspection shall be in accordance with AWS D1.1. Welding shall be performed by a Certified Welder in accordance with AWS D1.1, and inspection performed by an AWS CWI (Certified Welding Inspector). An acceptance report shall be submitted by the CWI upon completion of the work.

Remove the weld cracks at the repair location by grinding. Test the affected area using Magnetic Particle (MT) to determine if any of the crack remains. If part of the crack is still present, excavate and repeat the MT testing until the crack is gone.

- 1) Prepare the base metal; grind to bright sound metal, the affected areas to be re-welded, removing any zinc or paint coating.
- 2) If the pipe wall is penetrated, provide backing if possible.
- 3) Grind smooth any rough metal edges to be welded.
- 4) Preheat the base metal to a minimum of 100 degrees Fahrenheit.
- 5) The deposited fillet weld shall match the original fillet weld size.
- 6) Deposit filler metal per the attached W.P.S #CDOT 08-03, (Welding Procedure Specification).
- 7) Allow the repair weld and base metal to cool to ambient temperature.
- 8) Visually inspect the weld, and MT test.
- 9) Apply a zinc rich primer paint.

**Sample Welding Repair Procedure**  
**16.12 (K) -4**

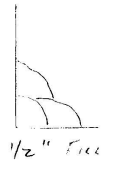
ANNEX E

AWS D1.1/D1.1M:2002

**WELDING PROCEDURE SPECIFICATION (WPS) Yes ☒**  
**PREQUALIFIED ☒ QUALIFIED BY TESTING**  
**or PROCEDURE QUALIFICATION RECORDS (PQR) Yes ☐**

<p>Company Name <u>C.D.O.T.</u></p> <p>Welding Process(es) <u>SMW</u></p> <p>Supporting PQR No.(s) <u>N/A</u></p> <hr/> <p><b>JOINT DESIGN USED</b></p> <p>Type: <u>CORNER</u></p> <p>Single <input type="checkbox"/> Double Weld <input type="checkbox"/></p> <p>Backing: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Backing Material: _____</p> <p>Root Opening _____ Root Face Dimension _____</p> <p>Groove Angle: _____ Radius (J-U) _____</p> <p>Back Gouging: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Method _____</p> <hr/> <p><b>BASE METALS</b></p> <p>Material Spec. <u>ASTM A709-36</u></p> <p>Type or Grade <u>36</u></p> <p>Thickness: Groove _____ Fillet <u>1/2"</u></p> <p>Diameter (Pipe) _____</p> <hr/> <p><b>FILLER METALS</b></p> <p>AWS Specification <u>A5.1</u></p> <p>AWS Classification <u>E7018</u></p> <hr/> <p><b>SHIELDING</b></p> <p>Flux <input checked="" type="checkbox"/> Gas _____</p> <p>Composition _____</p> <p>Electrode-Flux (Class) _____ Flow Rate _____</p> <p>Gas Cup Size _____</p> <hr/> <p><b>PREHEAT</b></p> <p>Preheat Temp., Min <u>100°</u> <u>MINIMUM</u></p> <p>Interpass Temp., Min <u>150°</u> Max <u>400°</u></p>	<p>Identification # <u>CDOT 08-03</u></p> <p>Revision <u>N/A</u> Date <u>12/10/08</u> By <u>M. STADIG</u></p> <p>Authorized by <u>M. STADIG</u> Date <u>12/10/08</u></p> <p>Type—Manual <input checked="" type="checkbox"/> Semi-Automatic <input type="checkbox"/></p> <p>Machine <input type="checkbox"/> Automatic <input type="checkbox"/></p> <hr/> <p><b>POSITION</b></p> <p>Position of Groove: _____ Fillet: <u>3F</u></p> <p>Vertical Progression: Up <input type="checkbox"/> Down <input type="checkbox"/></p> <hr/> <p><b>ELECTRICAL CHARACTERISTICS</b></p> <p><u>SMW</u></p> <p>Transfer Mode (GMAW) Short-Circuiting <input type="checkbox"/> <u>N/A</u></p> <p>Globular <input type="checkbox"/> Spray <input type="checkbox"/></p> <p>Current: AC <input type="checkbox"/> DCEP <input checked="" type="checkbox"/> DCEN <input type="checkbox"/> Pulsed <input type="checkbox"/></p> <p>Other _____</p> <p>Tungsten Electrode (GTAW) <u>N/A</u></p> <p>Size: _____</p> <p>Type: _____</p> <hr/> <p><b>TECHNIQUE</b></p> <p>Stringer or Weave Bead: <u>STRINGER</u></p> <p>Multi-pass or Single Pass (per side) _____</p> <p>Number of Electrodes <u>1</u></p> <p>Electrode Spacing <u>N/A</u> Longitudinal _____</p> <p>Lateral _____</p> <p>Angle _____</p> <p>Contact Tube to Work Distance <u>N/A</u></p> <p>Peening _____</p> <p>Interpass Cleaning: <u>GRINDER, HAMMER,</u></p> <p><u>WIRE BRUSH</u></p> <hr/> <p><b>POSTWELD HEAT TREATMENT</b> <u>N/A</u></p> <p>Temp. _____</p> <p>Time _____</p>
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## WELDING PROCEDURE

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			
<u>&gt; 5/16"</u> <u>MULTI-PASS</u>	<u>SMW</u>	<u>E7018</u>	<u>1/8"</u>	<u>DC</u>	<u>140-220</u>	<u>20-25</u>	<u>N/A</u>	

Form E-1 (Front)

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**Sample of Welding Repair Information**  
**16.12 (K) -5**